THE GENERAL PRACTICE MANUALS

(OTHER TITLES IN PREPARATION)

UROLOGY

in General Practice

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By

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Preface to Second Edition

If that thou wilt not read, let it alone:
Some love meat, some love to pick the bone.
      John Bunyan in "The Author's Apology"

THE ENTHUSIASM with which the first edition of this book was received was gratifying especially since it was published during the war when many difficulties conspired against us. It was a particular satisfaction to discover the number of specialists in urology who were interested in it. Something we had not anticipated was the use of the volume as a text for wartime medical students it is reported that, strangely enough, they actually read the book.

The specialty of urology is gradually becoming almost purely surgical. The treatment of gonorrhea, for example, has largely passed into the hands of the general practitioner and, because of the effectiveness of the sulfonamides and the antibiotics, the fate of this disease is definitely sealed.

In this revision I debated whether or not to drop the chapter on nephritis and finally decided to simplify and shorten it. The purists may object, but the practicing physicians like it. The chapter on the sulfonamides has been rewritten and expanded to include the antibiotics. Various other changes throughout the text have been made with the object of bringing the material up to date.

This revision was prepared without the aid of the junior author of the first edition.

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Urologic Diagnosis

MODERN METHODS of diagnosis in urology have made this specialty one of the most accurate in all of medicine and surgery Visualizing instruments such as the cystoscope, the urethroscope, the ureter catheter and the x ray in urography have all combined to make this possible. Examination procedures and methods of precise diagnosis are discussed in this chapter their application receives more detailed explanation in chapters dealing with particular problems of the genital and urinary organs and their diseases

The history of the patient and the result of the physical and spe cial examinations, as well as laboratory x ray and cystoscopic data, must be summed up and correlated. It is then that the diagnosis should become clear There is no substitute for what Sir James Mackenzie called "the art of the right scent. We sometimes en counter a student whose voluminous and exhaustive history of a patient proves only that he has completely lost the scent. Then one is tempted to remark, the more history the less diagnosis."

It is in working out the obscure and difficult borderline cases that peculiar insight and diagnostic ability are required. The keen diagnostician hears the patient s story and at once has some clues as to what may be the matter with the patient. Such an instantaneous, kaleidoscopic, mental process springs not from genius but from a wealth of clinical experience.

EXAMINATION OF URINE.—Examination of the urine is covered so completely in the various books on clinical diagnosis and labo-

ratory manuals that it is necessary here to stress only points not usually emphasized in these texts

Gross Examination —Before routine use of the microscope, examination of freshly voided urine with no other aid than the naked eye became a real specialty, known as "uroscopy" In many of the older books—those of 100 to 500 years ago—the physician is depicted holding the urine bottle up to the light Much can be learned from the gross appearance of freshly voided urine The multiple glass (two, three or five) test gives considerable valuable information. If the patient is able to void 300-400 cc of clear urine at a time, the inference is that the bladder is in a satisfactory condition

The patient should be told to come for examination with a full bladder. He is given two large glasses or bottles, each of 7 or 8 oz capacity, and asked to void into them, passing about 2 oz in the first and the balance in the second. If the first specimen is cloudy with pus and shreds and the second clear, the conclusion is that the seat of the disease is in the urethra or prostate If the patient with a full bladder voids only 50 cc, divided into two specimens, both of which are pus-laden, the conclusion is that the upper urinary tract (bladder, ureter, kidney) is seriously involved

There are sometimes a characteristic odor and appearance of the urine of a patient with calculous pyonephrosis (infected kidney full of stones) or calculous cystitis Usually such urine is pale and hazy with pus and shreds and contains long, ropy, mucus-like material The semisolid portion soon settles out, leaving an almost clear zone above The characteristic foul odor, when once sensed, is almost diagnostic of infected stones in the urinary tract When the urine has a fecal odor and sediment in the freshly voided specimen suggests feces, one may diagnose vesico-intestinal fistula

It is not uncommon to have a patient void as much as 400 to 500 cc of urine at one time and still not empty his bladder After simply shifting position or waiting just a few minutes, he may void another specimen of a quantity equal to the first In such an event one may suspect a large diverticulum of the bladder

Observing the character of the urinary stream in the male is often of value, for from this sign alone the various types of urethral obstruction such as stricture obstruction from a stone impacted in the urethra, prostatic hypertrophy and carcinoma of the prostate may be suspected. Bladder paralysis due to tabes or other neurogenic disorders also causes slowness and difficulty in urination.

The act of micturition is so complicated a nervous mechanism that sometimes sheer nervousness of the patient may cause not only delay in starting but incomplete emptying of the bladder

Blood in the urine may have many gross diagnostic characteristics. For example, when a patient passes urine, divided into two glasses, and the first glass contains fresh blood while the second is clear one may correctly infer that the blood is urethral in origin. Large clots in the urine may suggest massive hemorrhage from the kidney or bladder caused by tumor in either the bladder or the kidney The urine passed by the nephritic patient, particularly the patient with glomerulonephritis, may be merely "smoky". This may pass unnoticed by the patient but is highly important to the doctor The urine of the icteric patient has a characteristic yellow foam when freshly voided, and sometimes the jaundice can be first suspected from the urine which has a slightly bile-tinged foam. It can readily be seen that the astute physician can obtain a great deal of information from uroscopy alone.

Microscopic Examination —A drop of fresh urine should be placed on a clean slide and examined under the low power lens. Centrifuged specimens may be misleading at times. One looks for pus cells, red blood cells, casts and crystals. Motile bacilli seen in a specimen are generally Bacillus coli. A long process of culture is required to identify Bacillus coli further than this.

TECHNIC

After the uncentrifuged urine has been examined under the microscope, a centrifuged specimen is prepared. The sediment from this is spread on clean slides and dried over a flame and is then

carefully stained. One specimen is stained by Gram's method and one by ordinary methylene blue From the stained sediment one can obtain information regarding the character of the organisms found. It is at once apparent whether micro-organisms of either the cocci group or the colon group are present. It is important to discover in this way the predominating infecting agent. Only by the longer and more time-consuming method of culture of the urine, with isolation of the various colonies of bacteria, can more detailed information be obtained. Nearly three fourths of the time, the stained sediments and the more accurate culture methods will agree, so it can readily be seen that stained sediment is of considerable clinical value In the female, only catheterized specimens are of any value

Enumerating the pus cells or red blood cells in freshly voided urine is a routine method with us The ordinary blood-counting chamber is used. A drop of freshly voided, uncentrifuged urine is placed under the coverglass of the counting chamber by an ordinary medicine dropper. Ordinarily no dilution is required. The urine specimen is simply shaken and used. The cells are counted on a square millimeter and multiplied by 10, or the depth of the chamber which is 0.1 mm. By this simple method one obtains the number of pus cells or red blood cells per cubic millimeter The average high power microscopic field covers about one sixteenth of a square millimeter. When cells are reported on the basis of per high power field, as is commonly done, it is necessary to multiply the count by 160 to convert the figure into a rough estimate of the pus cells per cubic millimeter.

Reaction of Urine —Normal urine has an acid reaction, or a pH of about 5.5. Formerly all that was thought to be necessary was to test the urine with litmus paper to discover whether it was acid or alkaline Now we wish to know not only whether the specimen has an acid or alkaline reaction but also the degree of acidity or alkalinity. This is found by determining the pH, or hydrogen ion concentration. The pH of urine will vary from 4.8 on the acid

side up to 9 0 on the alkaline side. What was formerly called neutral
with the old litmus method is about 6.2 to 6 5 Normal urine has
a narrow variation of from pH 5 0 to pH 7 0

TECHNIC

To test the reaction, there are numerous color charts with accom
panying paper strips prepared chemically When dipped in the
urine to be tested, the strips turn various controlled colors which
can be matched with the color chart to obtain the pH reading One
of the most satisfactory of these sets is that made by E. R. Squibb
& Sons. By these charts the pH from 4 5 to 7 5 can be obtained.
These paper-strip methods are accurate within 0.2 as compared
with the more exact electric methods. There are other and more
accurate methods of titration and electrical determination of the
pH but the paper strip method is rapid and quite satisfactory

The reaction of the urine has considerable clinical importance
When giving mandelic acid, it is useful to estimate the pH of the
urine daily or several times a day to see that it keeps within the
optimal therapeutic limits. When alkalizing drugs are given, the
pH of the urine indicates the effectiveness of the medication. Certain
bladder infections, such as with Bacillus proteus, produce a con
stantly alkaline urine of a pH usually of 7 5 to 9 0 The progress
of treatment should be followed with daily or twice daily pH
estimations.

KIDNEY FUNCTION TESTS.—In urologic diagnostic procedures,
it is important to know approximately the functional ability of the
kidneys. Renal damage may then be estimated in percentages of
normal. Such kidney function tests are of two varieties (1) tests
of excretion, and (2) tests of retention. As far back as the time
of Hippocrates, measurement of the total quantity of urine passed
in 24 hours constituted a test of renal function. Even today we
carefully measure the intake and output of fluids to keep track of
the functional ability of the kidneys. Just who first noted that urine
had the odor of violets following ingestion of turpentine is not

known Neither does anyone know who first observed that eating asparagus produced a characteristic odor to the urine, but both these phenomena were noted by physicians thousands of years ago They were, in effect, the first kidney function tests Absence of these odors in cases of nephritis was first noted by Rayer in 1843

With development of the aniline dye industry came the use of aniline dyes to stain cut sections of pathologic tissue and also to stain bacteria The idea occurred to many that these dyes might be used as a measure of kidney excretion, but it was not until 1897 that Archard and Castaigne introduced methylene blue This did not prove to be very satisfactory and soon lost favor

In 1898, Lepine introduced rosanaline (rosanaline thiosulfate of soda) This test also failed to survive Indigo carmine was the next dye to be used for a kidney function test In 1903 Voellecker and Joseph introduced it for an excretory test The late B A Thomas of Philadelphia published exhaustive accounts of his research work on indigo carmine and popularized it in this country It is one of the tests that has survived and is still in routine use The ease with which it can be carried out recommends it One has only to inject 5 cc, or 1 ampule, of the dye into the vein of the arm Time is counted from the moment of injection The dye normally appears in the urine in good concentration in $2\frac{1}{2}$ to 7 minutes Delays beyond this time call for careful study

The phenolsulfonephthalein, or P S P, test is another which has survived The curious fact about this substance, which was synthesized by Ira Remsen, Professor of Chemistry at Johns Hopkins University, and his associates, is that these workers thought they had found a cathartic agent which could be used subcutaneously During animal experimentation on this drug, Abel and Rowntree in 1909 noted that this substance was eliminated by the kidneys Geraghty, who was working in urology with Young at that time, saw the possibilities of its use as a kidney function test In 1910 Rowntree and Geraghty published their findings The test, coming from the authoritative Johns Hopkins group, was at once accepted

and is still the most popular and reliable of the tests of kidney elimination.

There are many variations of the method of using phenolsulfonephthalein. Originally the method was based on the excretion of the dye in the first and second hour after intramuscular injection. The method used by E. Clay Shaw and modified by us is as follows

TECHNIC

Exactly 1 cc. of the 6 per cent solution of phenolsulfonephthalein is given intravenously One half hour prior to this injection, the patient is given about 1 000 cc. of water to drink. The question of whether or not to catheterize the patient who is unable to void for various reasons is important. In general unless the patient is hospitalized, a catheter should not be passed. In the case of the prostatic patient, it is best to leave the catheter in the urethra as permanent drainage if one is used. When it is not necessary to secure a catheter in the urethra, the patient voids every 15 minutes or more often if necessary Four specimens are collected and marked

<div align="center">

1st 15 minutes
2d 15 minutes
3d 15 minutes
4th 15 minutes

</div>

This collection must be done carefully and all the urine voided in the first 15 minutes must be put in the bottle so marked. All four specimens must go to the laboratory It is a simple matter to alkalinize them, using a few drops of 10 per cent potassium hydroxide solution to bring out the red color of the dye, then diluting to a standard and comparing in a colorimeter to obtain the percentage readings of the dye excreted. There are many inexpensive colorimeters.

In a study of a large series of normal individuals it has been found that the normal pair of kidneys will excrete, in the

First 15 minutes 40-42 per cent of the dye
Second 15 minutes, 18 per cent

Third 15 minutes, 8 per cent

Fourth 15 minutes, 7 per cent

A shift of the peak of excretion to the second, third or fourth 15 minutes indicates impaired renal function and requires study

Many other tests have been used, such as the freezing point determinations as well as tests with many other dyes and chemicals, but these are now only of historic value The best tests of retention are the various estimations of urea nitrogen, nonprotein nitrogen and creatinine in the blood. These, however, are not strictly speaking tests of renal function

EXAMINATION OF URINE FOR TUBERCLE BACILLI — This is a relatively simple procedure It is almost always dinned into the ears of the student of medicine and student technician that it is difficult to find and properly stain tubercle bacilli in urine, whereas it really is not difficult.

The practitioner should be reminded that the tubercle bacillus is covered with a waxy coat or envelope which generally causes the organism to float near the top of the urine specimen After prolonged centrifugation, the organisms are sometimes at the top of the centrifuge tube instead of with the rest of the sediment at the bottom Our method, which we have used for years, is as follows

TECHNIC

1 Collect a large quantity of the suspected urine, for example, all urine passed in 24 hours

2 Allow the urine to stand in a large jar or container for 24 to 36 hours at room temperature

3. At the end of that time, pipet off about 50 cc of the sediment from the bottom of the container and centrifuge

4 Transfer some of this solid sediment to a slide and stain with carbolfuchsin (see below)

5. If tubercle bacilli are not found, pipet off several centrifuge tubes full and spin for 25 to 30 minutes

6. Examine this sediment (using the procedure given below)

This method gives a higher percentage of positive results than any other for the simple reason that the organisms become water logged when the urine is allowed to stand for 24 to 36 hours. They then lose their buoyancy become heavier than the urinary medium and sink slowly to the bottom. When such a water logged sediment is centrifuged, the organisms are more readily found. Once the sediment is fixed to the slide the procedure is as follows

Carbolfuchsin stain is used. This is made up of 1 part of basic fuchsin and 10 parts of absolute alcohol, diluted with 90 parts of 5 per cent carbolic acid aqueous solution

1 Flood the carbolfuchsin on the slide and heat over a flame or other heater for several minutes or until it steams well

2 When the film is deeply stained, wash and dip the slide in a 2 per cent hydrochloric acid in 95 per cent alcohol solution, called acid alcohol. Decolorize with this acid alcohol solution until the film shows no red.

3 Wash the slide in water

4 Stain again with ordinary methylene blue for contrast.

5 Wash and dry with blotting paper or gentle warming and examine under the oil immersion microscope lens.

There are other good methods. In certain laboratories the culture method has been brought to a high point of perfection and is quite reliable. In general guinea pig inoculation should be carried out in every suspected case although the results are not completely infallible.

EXAMINATION OF MALE GENITALIA.—The male external genitalia consist of the penis, the scrotum and its contents. Examination of the penis is more important than at first appears. The lesions to be found are dealt with in more detail in Chapter 16 "Diseases of the External Male Genitalia."

It is important to recognize urethritis, particularly in the male and to make smears for microscopic examination.

TECHNIC

Two clean glass slides are essential The urethra is squeezed by a stripping motion with the thumb and two fingers of the left hand When the drop of pus appears at the meatus, a slide is touched to the drop This slide is used to make a thin spread on the second slide With a little practice, better spreads can be made this way than with a platinum loop When the discharge is profuse, it is necessary to squeeze out the first part and then cleanse the meatus with a pledget of cotton before obtaining the specimen It is important to make thin smears or spreads It is not necessary to heat the slides to fix the film, merely dry them The dried spreads are stained with ordinary methylene blue for the first observation Extra smears may be made for study by Gram's staining method if that seems necessary

Ordinary observation will detect phimosis Paraphimosis calls for immediate treatment which consists of replacing the retracted foreskin on the glans penis (See Chapter 16 for details on phimosis and paraphimosis and their treatment) Palpation may reveal plaques along the shaft of the penis Any open lesion should be carefully examined since primary syphilitic sores take on many variations Precancerous lesions, like the various types of warts and persistent or recurring lesions, should be viewed with suspicion and observed again and again

Scrotum and Its Contents —Examination of the scrotum and its contents is exceedingly important It is well to have palpated a number of normal types so that the normal is clearly fixed in mind, otherwise, a normal epididymis may be mistaken for a small tumor It is so important that the small or early teratoma be found that every small lump that seems to be in the testicle should be examined again and again, but gently lest stray malignant cells be broken loose to become implanted in distant fertile soil. Further, we would advise excision and detailed study of every such lump (for further discussion, see Chapter 16) Hard lumps in the epididymis suggest tuberculosis, which is a common disease of this organ The small

hard testicle is frequently gummatous, in which case the patient's Wassermann reaction is positive It is important to distinguish hydrocele hernia and tumor which may occur alone or coexist. It is
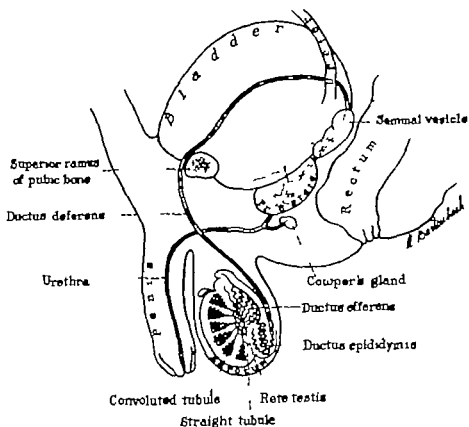
FIG. 1—Anatomic relationship of urinary bladder and male genital organs.

sometimes difficult to distinguish between hydrocele and sperma tocele When aspirated by means of a needle and hypodermic syringe, the former has a clear fluid and the latter a milky fluid which, under the microscope is found to contain millions of sper matozoa. The spermatocele is literally a series of cysts of the epidi dymis. Diagnosis of varicocele is important, but the finding of small varicoceles had best not be disclosed to the patient (see Chapter 16 for further details)

Examination of the Prostate —The prostate is one of the hidden organs The importance of making a rectal examination is twofold (1) to examine the prostate, and (2) to examine the rectum The

Foreign Body

Hunner's ulcer

Simple ulcer

Trigonitis

Vesico-vaginal fistula

Chronic urethritis

Urethral caruncle
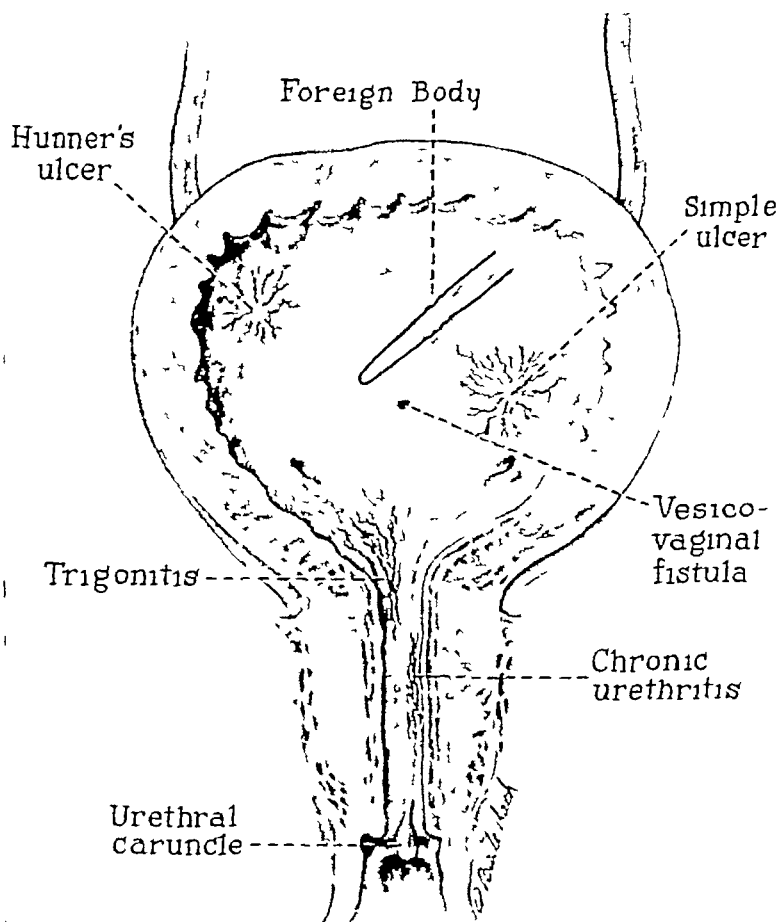
FIG 2 —Female bladder, showing vesical and urethral lesions

patient can be examined with the gloved index finger, and much can be learned by simple palpation The normal prostate is about the size and shape of an edible chestnut If one examines the prostate in every patient as a routine, the sense of what is normal will soon be developed One must not fall into the error of palpating

a full bladder and thus being misled into believing that a very large prostate is present. A stony hard prostate nearly always means cancer. We say "nearly always" for in a few cases the prostate is hard and it is *not* cancerous. Sometimes prostatic calculi can be felt by rectal touch. They may be extremely hard and fixed, and sometimes actual crepitation can be elicited. This subject is more fully discussed in Chapter 14.

THE FEMALE URETHRA.—This important organ is about 1¼ in. long. It is the seat of many painful disorders which are described in Chapter 18. It is important to examine the various exudates which can be squeezed out of the urethra. Strictures occur more often than is generally supposed. Tumors arising from Skene's glands and metastatic growths from the cervix are not uncommon. The two commonest lesions are the ordinary caruncle and partial prolapse of the urethra.

Examination of the Bladder.—Examination of the bladder should begin with palpation of this organ through the abdominal wall. In the female, bimanual examination can be done with one hand in the vagina and the other on the suprapubic region. In this manner tumors with hard bases and large stones can be identified. The older method of passing a stone searcher which was nothing more than a slender metal sound with a rounded bulbous end, into the bladder and eliciting a click when a stone was encountered, is still valuable for diagnosing stone in the bladder. When presence of a stone is noted by this method, it is simple to confirm the diagnosis by cystoscopy or roentgenography.

Examination of the urine as was stated before, may constitute one method of determining the pathologic condition of the bladder.

CYSTOSCOPY.—We believe that the cystoscope is a diagnostic instrument which more and more practitioners should learn to use. Some special training is, of course, necessary. Practically all medical graduates of the past 15 years have had at least a rotating hospital internship that included some cystoscopy.

By following the simple rules and suggestions presented here, the

practitioner should be able to do a considerable amount of satisfactory diagnostic work, particularly in female patients

To make a cystoscopic examination of a male patient, one should have had considerable cystoscopic training, since instrumentation of the male urethra is not to be approached lightly There are certain
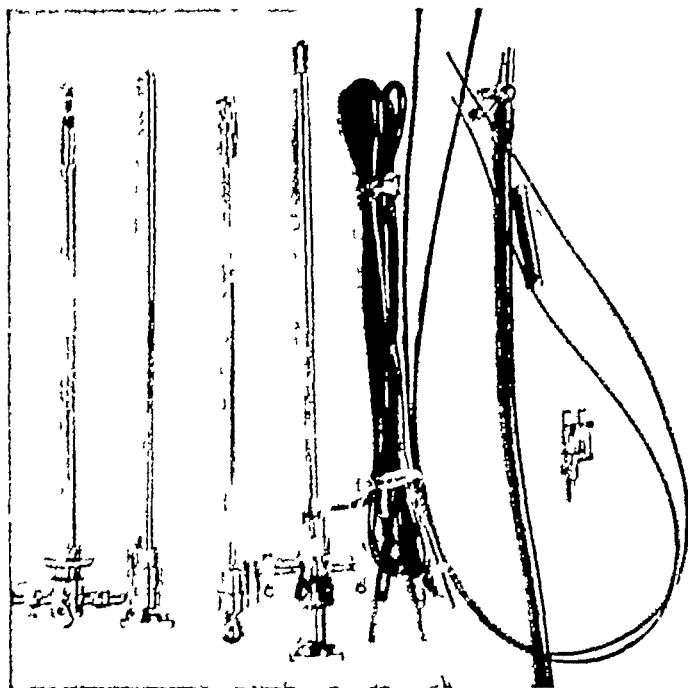
FIG 3A —Parts of Brown-Buerger cystoscope From left to right sheath, observation telescope, obturator, double catheterizing telescope, cord to carry current from battery to lamp, two ureteral catheters, water connector, connector for Luer syringe to ureteral catheter, and light carrier which connects cord to cystoscope

contraindications to cystoscopy in either the female or the male as far as the nonspecialist is concerned These are (1) acute retention of urine, (2) fever and chills, (3) infected urine from infected bladder or kidney, (4) infected urethra (either male or female), (5) stricture of the urethra, (6) prostatic hypertrophy, (7) anuria

Modern cystoscopes have small caliber and large visual field A universal cystoscope for use by one who is planning only diagnostic

procedures is the new Brown Buerger no 16 F., made by the American Cystoscope Makers. This little instrument has a wonderful visual field which looks at a right angle to the long axis of the telescope periscope fashion. If one can afford two cystoscopes, the second one should be the McCarthy 4 oblique panendoscope The new
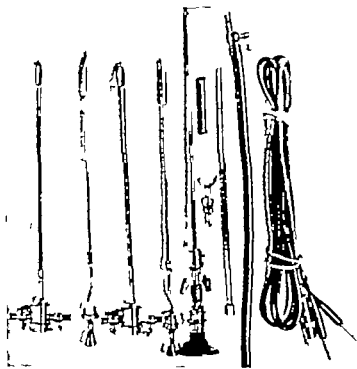
FIG. 3B—Parts of McCarthy cystoscope. From left to right no. 22 sheath, and its obturator no. 24 sheath, and its obturator combination observation and catheterizing telescope catheter connector light carrier catheter guide; water connector and light cord.

68 A lens has a 15 degree forward looking system which is also valuable for viewing the urethra, particularly the prostatic and the female urethras

For cystoscopy the necessary equipment includes

1 Cystoscope
2. A source of adequate sterile water in a closed gravity system
3 Lubricating jelly

4 Metycaine crystals

5 Metycaine solution, 2 per cent

6 Sterile cotton applicators on wood sticks

7 A battery to light the cystoscope

8 Cord to the cystoscope

TECHNIC IN THE FEMALE

1 The cystoscope is sterilized by washing it with soap and warm, not hot, water, using a soft brush to get in all the crevices It is then placed in a bath of 1 5,000 mercury cyanide solution for 20 minutes, which will sterilize the instrument thoroughly

2 The water source is important By obtaining the bottles or containers supplied by Abbott Laboratories for intravenous saline solution, a closed sterile system can be had The tubing leading from the bottle is connected to the cock on the side of the cystoscope Sterile water can then be used to fill the bladder and distend it

3 The cord and light are then tested and adjusted

4 The patient is prepared by removing all clothing and donning a clean gown.

5 Next the patient is placed on her back on a suitable table with leg rests of the Bierhoff type

6 The vulva and urethral meatus are cleansed with soap and water, followed by mercury cyanide solution

7 Next a cotton applicator is dipped in 2 per cent metycaine jelly, slipped gently into the urethra and allowed to remain there for two minutes to anesthetize the urethra The bladder is then emptied with a sterile, soft rubber catheter and about 10 cc of 2 per cent metycaine solution is introduced into the bladder through the catheter

8 The cystoscope is picked up out of the mercury cyanide bath, its tip is dipped in the lubricating jelly or glycerin (never use vaseline, mineral oil or other oily substance) and introduced into the bladder

How to See —In using the cystoscope, one should imagine that

the instrument is in the center of a clock dial (Fig 4) The 12 o'clock point is straight up and since the patient is lying on her back, this will point to the anterior abdominal wall Whenever water is allowed to run into the bladder through the cystoscope a little air is inadvertently introduced, and this air collects at the highest point in the form of a bubble The bubble marks the 12 o'clock point on the imaginary clock dial Directly opposite is the
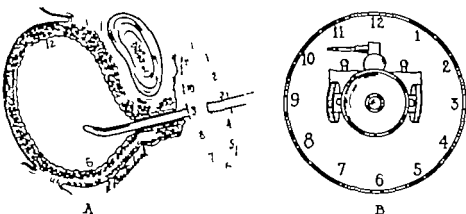
FIG. 4.—Imaginary clock dial to aid in orientation with the cystoscope With the patient on his back, the bubble in the bladder indicates 12 o'clock and the middle of the trigon, 6 o'clock.

6 o'clock point, and this is in the middle of the trigon. At the 8 and 4 o'clock points are the right and left ureters, respectively

There are three essential movements of the cystoscope in the hands of the operator (1) a rotary movement, (2) a swinging lateral or up-and-down movement, and (3) an in and-out movement. These three maneuvers and combinations of them will enable the cystoscopist to see the entire inside of the bladder To perfect the technic without subjecting patients to needless cystoscopies, an ordinary rubber ball 4 or 5 in. in diameter will prove a useful device. A hemispheric slit is made, dividing it into almost two halves, using adhesive plaster to form a hinge to hold the "lid" on. A small hole is then made below just large enough to admit a cystoscope

and to represent the urethra The inside of the ball can be painted to resemble the normal bladder Two small holes can be punched where the ureters should be With this device one can, by practice, become proficient in use of the cystoscope

In order not to miss important pathologic changes, it is necessary

FIG 5 —Section of the bladder showing the trigon, urethra and ureteral orifices
(Courtesy of the American Cystoscope Makers, Inc.)

to follow a routine in observing the interior of the bladder First, the instrument is rotated toward the dome or vertex of the bladder which, with the patient in the dorsal position, is the anterior superior portion The bubble rests at this point The anterior edge of the sphincter of the internal urinary orifice can be seen here Next, the instrument is rotated to the left and right to inspect the lateral walls of the bladder While carrying out these movements, the instrument is moved in and out so that the entire area can be inspected It is, of course, necessary to overlap the visual fields so as not to miss any

part of the area. The area of the posterior wall and trigon is inspected last. The trigon is the triangle formed between the two ureteral orifices and the internal urinary meatus, and at least 75 per

Fig. 6.—Showing how one looks at right angles to the long axis of the cystoscope. Orientation is obtained by knowing the position of the bubble and the trigon. (Courtesy of the American Cystoscope Makers, Inc.)

cent of the pathologic lesions seen are in and around this area.

What to See—One should observe overhanging fronds or irregularities around the internal urinary meatus in the female These, in general, have no significance whatever although they are thought by some urologists to be important.

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Labels on figure:
- 2
- Air bubble at vertex of bladder
- Rim of bubble
- Bladder
- SYM
- 1
- Brown Buerger cystoscope (looking upward)
- Trigon
- Bladder distended

FIG. 6.—Showing how one looks at right angles to the long axis of the cystoscope. Orientation is obtained by knowing the position of the bubble and the trigon. (Courtesy of the American Cystoscope Makers, Inc.)

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What to See—One should observe overhanging fronds or irregularities around the internal urinary meatus in the female. These, in general, have no significance whatever although they are thought by some urologists to be important.

In inspecting the trigon and ureteral orifices a great many different variations can be noted One should note the ureters on each side, for sometimes there are extra ureters Rarely, there may be as many as three ureteral orifices on one side If there is mild inflammation of the bladder, it is likely to be centered around the trigon and should be seen as a definite zone of redness which ends sharply about the level of the ureteral orifices
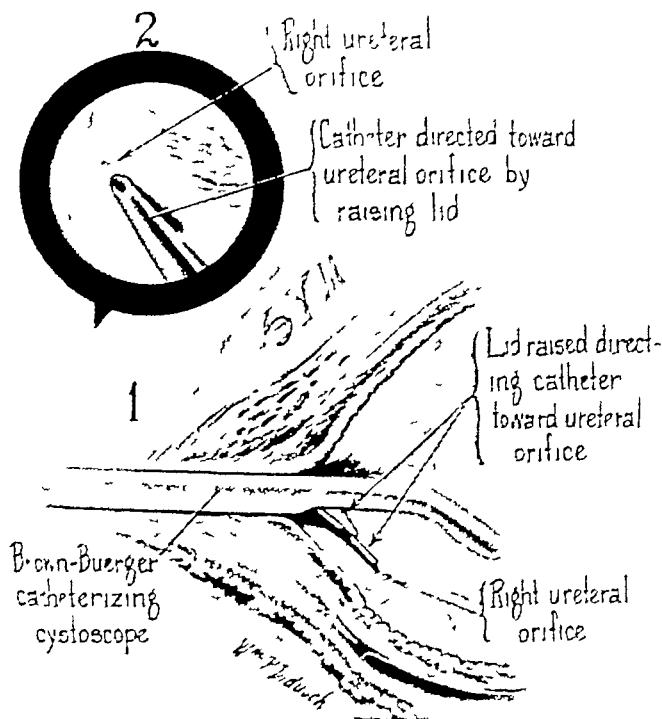
FIG 7 — 1, the cystoscope in position 2, ureteral catheter is ready to enter the ureter (This and Fig. 8, courtesy of the American Cystoscope Makers, Inc.)

The condition of the bladder mucosa should be noted. Ordinarily the interior of the bladder is salmon-pink, with blood vessels clearly seen on the surface In inflamed bladders the mucosa is dull red and the blood vessels are obliterated The interior of the Negro bladder is a deeper red than that in the white race Since the view is distorted by overdistention or a nearly empty bladder, the amount of fluid contained in the bladder must be carefully gaged

Papillomas and bladder tumors are not difficult to detect, but it is important to know what they look like for there are many variations (see Chapter 13)

Sometimes the ureteral openings appear as round, watery balls or cysts such endings are called ureteroceles. They are rare but sometimes cause many unpleasant symptoms.

Stones in the bladder are easily detected because they can usually be seen as white rounded phosphatic deposits.
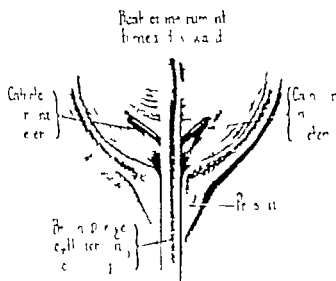
FIG. 8—Ureteral catheters have been pushed up the ureters to the kidneys. The cystoscope will now be withdrawn, leaving the catheters in the ureters.

One may inject indigo carmine intravenously and observe with a cystoscope the appearance time and concentration of the dye at the ureteral orifices. This is known as *ureteroscopy* and is an important rapid test of kidney function. If no dye appears from one side and plenty of dye appears from the other one may conclude that one kidney is not functioning. However repetition of the test on another day and more study are advisable before a kidney is condemned.

Diverticula of the bladder are also important. They appear as rounded holes which look like complete defects in the

These can be filled with opaque medium and stereoroentgenograms taken to determine their size and position (Fig 9).

Ulcers of the bladder may be found. In Chapter 13 we describe more fully the kinds of ulcers to be seen. The commonest is Hunner's ulcer, which is often not easily diagnosed and is frequently missed even by specialists in urology If the symptoms which accompany this disease were kept in mind, the condition would be much
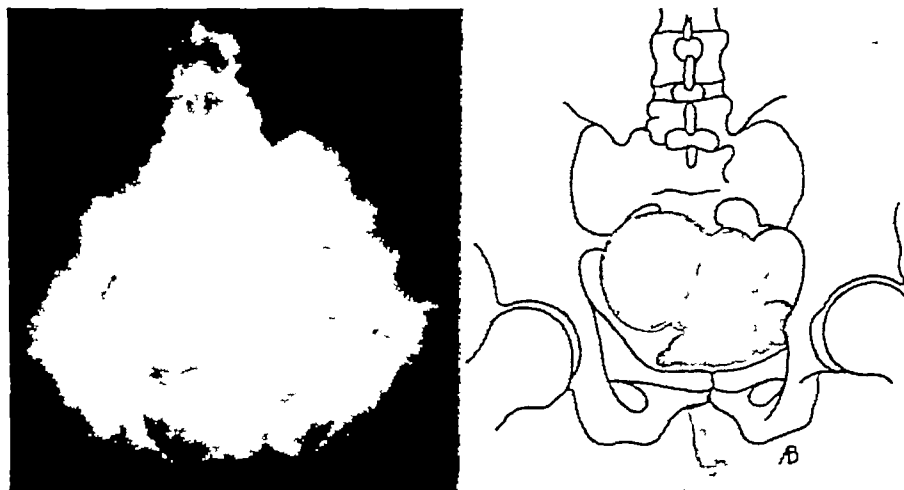
FIG 9—Large diverticulum of bladder with several smaller ones, and fibrous contracture of vesical neck.

more frequently diagnosed. Briefly, its diagnostic characteristics are (1) pain when the bladder is full, (2) pain at a definite spot, nearly always directly over the ulcer, (3) clear urine, no pus or blood early, (4) frequent and painful urination, day and night.

RADIOGRAPHY AND UROGRAPHY —Radiography is the handmaiden of urology. No two specialties are more closely linked Almost every practitioner today has a small but efficient diagnostic x-ray apparatus as a part of his equipment.

The plain x-ray plate of the urinary tract, or what is generally called the K.U.B (kidneys, ureter, bladder) plate, tells much. Every urologist who has passed his specialty board is an expert in the interpretation of x-ray plates It is not too much to ask the specialist

r his opinion on any plate the practitioner may make. The making f good x-ray plates is a technical job that can be done well by anyone with a little training. The interpretation of the plates is ighly specialized. The instructions that come with every new x ray utfit generally tell the technical details of how to make plates of e various parts of the body A few suggestions on how to get good idney and ureteral fillings on intravenous urographic plates will e given here.

FIG. 10—Ureteral catheter penetrated ureteral wall and opaque medium was diffused into retroperitoneal space along the course of the ureter This caused no untoward symptoms.

TECHNIC

The patient who is ambulatory and not chronically constipated needs little or no preliminary catharsis as preparation for intra venous urography We have no difficulty with intestinal gas. On the other hand, after a few days in a hospital the gastro-intestinal tract of the same type of patient has gas and fecal material, and castor oil is needed, followed by enemas to cleanse the tract. The patient coming to the office should be ordered to take no fluids from 6 o clock the night before and to come without breakfast.

Solutions of diodrast or neo-iopax can be used for the opaque medium. A sensitivity test should be made on every patient, for use

of these apparently inert substances is not without danger In the test a drop of the solution should be placed on the patient's forearm or upper arm, spread around and allowed to remain for two or three minutes If the substance produces a red zone in a few minutes, it should not be given intravenously because the patient is sensitized to it and will probably have an untoward reaction If no skin re action occurs, it is safe to inject the opaque medium, but with certain precautions (1) The solution should be warmed to body tempera- ture (2) A fine needle, say 24 gage, should be used and as long as five or six minutes by actual timing should be taken to make the injection Seven or nine minutes after the injection is completed, the first plate is taken If good plates are obtained then, another plate should be taken immediately However, if nothing appears during that time, then a plate should be taken in 15 minutes and another in 30 minutes Sometimes the "dye" (or opaque medium) does not appear at all and the attempt to visualize the urinary tract is a complete failure A further function test should then be made to see whether function is so low that the dye cannot be visualized, use of diodrast or neo-iopax in itself is a kidney function test

In succeeding chapters will be shown pyelograms of typical cases of various diseases of the kidneys, ureters and bladder If these are carefully studied, correct diagnosis can be made in many instances

Hematuria

GENITO-URINARY CAUSES —There are seven cardinal conditions arising in the genito-urinary tract which cause hematuria

1 *Papilloma of the Bladder* —Aside from nephritis, these lesions are by far the most important from the patient's point of view The more astute older physicians always regarded painless hematuria pathognomonic for papilloma of the bladder, and that assumption was correct Bright red blood passing painlessly from the urethra, in male or female, aged 30 or more, calls for immediate investi- gation

One must keep in mind the fact that all papillary growths in the
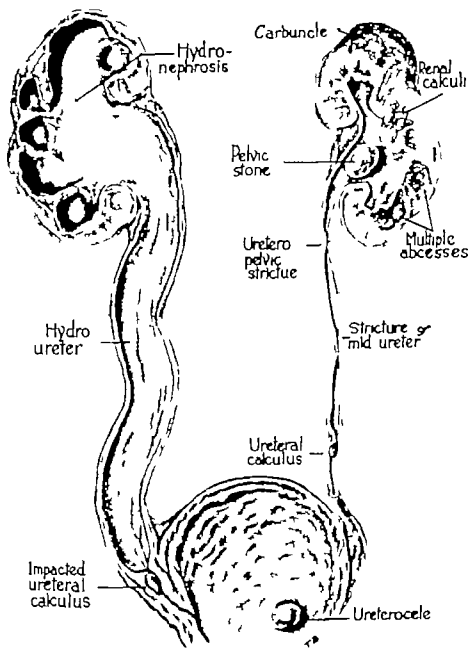
FIG. 11 —Various conditions which may occur in the upper urinary tract.

Labels on figure:
- Hydro-nephrosis
- Carbuncle
- Renal calculi
- Pelvic stone
- Multiple abscesses
- Hydro ureter
- Uretero pelvic stricture
- Stricture of mid ureter
- Ureteral calculus
- Impacted ureteral calculus
- Ureterocele

bladder are malignant, even though some pathologists persist in reporting certain bladder growths as benign papillomas. Clinically they are malignant and vary only in degree Some pathologists grade them 1, 2, 3 and 4, in increasing order of malignancy Papillomas often change from grade 1 to grade 4, spreading by implantation When a patient with painless hematuria presents himself, he should be plainly told of the possibilities and a cystoscopic examination at a hospital should be insisted on If a small papilloma is found, it can be studied immediately by biopsy and often permanently destroyed by desiccation with the electric current After that, the patient should be examined carefully at intervals of 90 days Cystoscopic examinations at these intervals are imperative, since there may be recurrence without even microscopic red blood cells showing in the urine Treatment, therefore, is surgical.

2. *Tumor of the Kidney.*—The blood may come directly from the kidneys. Such a discovery in connection with painless hematuria should be followed by complete cystoscopic examination It is of the utmost importance to discover the functional state of the good kidney, for until that is done no operative procedure on the supposedly pathologic kidney should be undertaken X-rays of bones should be made in the search for possible metastases

3. *Tuberculosis of Kidneys, Bladder or Genitalia* —Genital tuberculosis, including renal tuberculosis, sometimes produces hematuria, although this is not constant.

4 *Calculi.*—A calculus anywhere in the urinary tract—kidney, ureter or bladder—may cause marked hematuria because it traumatizes the structures contiguous to it This is due to the rough exterior of the stone which is sometimes covered with sharp spicules of hard crystals Inflammation around the stone also plays a part However, most calculi have smooth surfaces and do not cause bleeding

5 *Prostatic Hypertrophy* —It is not generally recognized that the benign hypertrophied prostate bleeds more frequently than the malignant one One is misled into suspecting malignant disease when one sees blood flowing without apparent cause. The prostatic

patient usually has acute dysuria and pain in the region of the prostate when the blood appears. Sometimes the hemorrhage is massive and soon fills the bladder with clots.

6. *Urethritis and Strictures* —Urethritis in certain instances causes marked hematuria.

7 *Cystitis* —There is great variation in both severity and type of this disorder It is discussed fully in Chapter 13

SYSTEMIC CAUSES.—Many serious systemic diseases are accompanied by varying degrees of hematuria. In nearly every instance the bleeding is renal in origin and due to the accompanying nephritis. For this reason, many writers have named nephritis as the number 1 cause of blood in the urine One might as easily divide the causes into local and general, and medical and surgical since the systemic group of causes falls almost entirely into the medical group, while the lesions of the genito-urinary tract come principally within the scope of the surgeon.

1 *Nephritis* —Glomerulonephritis is the principal cause of hematuria. The blood may appear in the urine as a smoky opacity as microscopic red blood cells and occasionally as massive bilateral renal bleeding.

2 *Acute Infectious Diseases and the Exanthemas* —Many severe diseases, such as pneumonia, scarlet fever smallpox, the various types of malarial fever typhoid fever typhus fever Rocky Mountain spotted fever and similar systemic diseases throw such a burden on the kidneys that toxic nephritis is set up which liberates blood in the urine and is in reality a hemorrhagic glomerulonephritis.

3 *Localized Infections with Systemic Reactions* —Certain localized infections either adjacent to or at a distance from the urinary tract may cause hematuria from the nephritis set up by the disease A few such causes are empyema carbuncle, appendical pelvic and liver abscesses, peritonitis, osteomyelitis and similar infections. Occasionally an appendical abscess overlies the ureter in such a fashion as to cause local inflammation in the ureter and some blood in the urine, both microscopic and gross.

4 *Blood Dyscrasias*—Almost all patients with a blood dyscrasia have hematuria some time in the course of the disease Among these blood diseases are the various anemias, pernicious anemia, leukemia, Hodgkin's disease, hemophilia, erythremia and purpura Syphilis may account for a small number of cases Purpura (of which there are many variations) may cause rather severe hematuria

5. *Drugs*—Certain drugs and chemicals have a definite irritating effect on the kidneys One of the latest drugs, or perhaps it should be designated a chemical, is mandelic acid Under certain conditions some of the sulfonamides may produce mild hematuria It is well known that in certain individuals turpentine taken internally causes hematuria Urotropin, or methenamine, in large doses frequently causes hematuria Cantharides, bichloride of mercury, lysol and many other drugs and chemicals will produce hematuria because they set up chemical nephritis

Pain

Pain is an important symptom The physician has no way of knowing the degree of pain except from the patient's statement and his actions Undoubtedly what is unbearable pain to one person is merely an annoying ache for another In this brief outline, pain will be considered from its anatomic source, i.e, the pain distribution of the organs affected

Pain Arising from the Kidneys—The patient frequently states that he has pain over his kidney when, as a matter of fact, the pain does not originate in that organ The surface distribution of pain arising from the kidney has been demonstrated both clinically and experimentally If the costovertebral angle is taken as a center and a circle with a radius of 5 cm is drawn around this center, the area of pain which arises from the interior or pelvis of the kidney will be included. The pain may be described by the patient as sharp, cutting, lancinating or stabbing, dull or heavy aching, throbbing or a feeling of fulness or pressure The pain that arises from stretching of the kidney capsule, when the kidney itself is obstructed and filled

with urine has more surface distribution than that previously mentioned.

Renal Colic —The clinical picture of violent renal colic has been seen by almost every practitioner but a description of severe renal colic is not out of place at this point.

One might state that the patient has no warning. Suddenly, out of a clear sky and usually just after arising in the morning the patient is seized with a lightning like paroxysm of pain so severe and agonizing that he rears at the affected side and rolls on the floor He twists constantly rolling from side to side to get away from the demon in his vitals. If he can speak at all he may tell you that the pain is cutting boring burning or use any other term he can think of at the moment. The picture of a patient in the agony of an attack of renal colic should be burned into the mind of every practitioner of medicine. Onset is sudden pain is intense No matter how phlegmatic or stoical or stout hearted the individual may be he succumbs to the body racking violence of the pain.

The pain generally starts in the kidney area around the costovertebral angle and sometimes seems to go through to a point in the front of the abdomen. It radiates down along the course of the ureter it never radiates upward (gallbladder pain does) Sometimes the whole of the affected side becomes not only rigid but tender The patient usually has a normal or subnormal temperature during the attack and generally is pale and covered with cold, clammy sweat. Feet and hands are cold and the pulse is thready and rapid, the rate usually around 100 He feels ill and retches, even if he does not vomit, though vomiting is often an accompaniment. At first he vomits recently eaten food and later bile and blood-stained mucus. If the abdomen is distended and rigid on the right side and there is constipation, the practitioner who sees him may think he has an intra abdominal lesion, such as an appendical attack or an intestinal obstruction. If the patient has had previous attacks, he recognizes his own trouble and tells the physician he is having another "stone attack."

If the calculus has entered the ureter and is somewhere in its upper third, the pain may spread down along the course of the ureter to the "ureteral focal point of pain," into the genitalia and down the inside of the thigh As the calculus moves down with each intermittent attack of colic, the distribution of pain changes but always follows the same general pattern. The area of distribution, as shown by our experimental studies, is remarkably constant As the calculus nears the bladder, symptoms of frequency and dysuria develop Blood may be present in the urine in amounts varying from a few microscopic cells to gross hematuria

The Ureter.—It is important that the physician know the surface distribution of pain arising from the ureter Our research work has shown that different levels of the ureter have definite surface areas to which they are referred. The surface area to which pain arising in the ureter is distributed is as follows· beginning over the crest of the ilium and proceeding down just medial to the inguinal region, to the genitalia and down the inside of the thigh and leg to the toes, sole or heel. The constant point of ureteral pain is on each side of the midline and just beyond or below a line drawn between the anterior superior iliac spines The various levels to which the pain is referred vary with the individual (Fig 65, p 216)

The Bladder—The normal bladder when distended with urine causes pain and an intense desire to urinate The combination of pain, difficulty, burning, frequency, etc., is called dysuria. In paralysis of the bladder and sometimes in prostatic obstruction, the bladder dilates to tremendous capacity without causing pain or even perception of fulness A stone in the bladder may cause a burning pain referred chiefly to the deep urethra, perineum or end of the penis, and sometimes to the scrotum and down the inside of the thigh Suprapubic pain is just above the symphysis in the midline The patient generally knows when he has pain in the urinary bladder and can describe it accurately enough that the physician may investigate the cause.

The Prostate —Sensations arising from this organ include a deep

aching in the perineum, a pain in the rectum, a teasing desire to urinate, vague, indefinite suprapubic pain, pain referred to the sacral or lumbar region or pain referred to the end of the penis. Frequency of urination caused by inflammations of the prostate is generally accompanied by burning, smarting and aching in the perineum. Pain arising from the trigon, prostate or posterior urethra cannot be distinguished.

The Seminal Vesicles.—Pain arising from these organs is in no way different from the pain sensation generated by the prostate, and only careful investigation will reveal the true source of the trouble.

The Urethra.—The patient can always recognize pain in the urethra, which is the seat of many inflammations and diseases. Acute gonococcic infections are recognized even by the patient, and the pain is characteristic. Strictures of the urethra may be painless, but at certain times the pain may be referred to the glans penis even though the source is in the deep or posterior urethra. Spasmodic contractures of the urethra occur from many different causes.

The Spermatic Cord.—Pain in the spermatic cord is usually called a neuralgia. It may be due to many causes, not the least of which is ungratified sexual desire. Such pain in the spermatic cord may also be, and often is, the prodromal sign of epididymitis.

Testicles and Epididymis.—Pain in the testicles, or testicle is a severe aching sickening sensation. Trauma is probably the most frequent cause of such pain. The various inflammations which affect the epididymis will also affect the testicles. Rapidly growing tumors of the testicle are sometimes painful. In acute epididymitis the pain may be due to the inflamed or swollen epididymis, to extravasation of urine or to some gross lesion which is of more concern to the patient than the pain which may arise from it.

Disturbances of Micturition

Under this general heading come frequency, painful urination, dysuria, difficulty, polyuria, oliguria and anuria, incontinence, uremia and enuresis.

300 cc. output per day anuria or total suppression of urine may be impending

The difference between anuria and retention of urine should be recognized. Anuria means that no urine is produced by the kidneys while retention of urine means that urine is secreted but none can be passed because of obstruction.

Incontinence—Incontinence of urine may be due to paralysis of the bladder or obstruction of the urethra or prostate which causes the bladder to fill to capacity and overflow of urine a little at a time, making a continuous dribble. This is sometimes called para doxical incontinence, i.e., incontinence with a full bladder or over flow incontinence

Uremia.—Uremia is a systemic disorder which results from reten tion of an excess of certain urinary waste products. If for instance, certain nitrogenous products are not excreted by the kidneys, the uremic state develops. Uremia, of course, may also be caused by an obstruction in the bowel which also produces retention of nitrog enous products. It is a strange fact that certain individuals may with kidneys which are gradually failing from disease, have a chronic uremic state which continues for many months or even years.

Enuresis—Enuresis is definitely one of the most difficult diseases the practitioner has to manage, if indeed, it can properly be called a disease entity It usually occurs in children. Bed wetting and enuresis are synonymous terms. However enuresis is by no means confined to children, for it may be carried over into adult years and become very embarrassing

In patients with enuresis it is well, of course to examine the urinary and genital tracts thoroughly to see if there may be some hidden source of the difficulty Certain anomalies, like the ectopic ureter which opens beside the urethra or in the cervix of the female, may cause constant dripping of urine which causes bed wetting We have known such cases. Also the ectopic ureter which opens in the prostatic urethra in the male may give rise to "enuresis" But this is

Frequency—Frequency of urination is a subjective sign of considerable importance, for it is a common symptom of many urinary diseases The patient's evaluation of it may vary with his temperament. In certain women nocturnal frequency may be induced by nervous states from various causes Elderly men with nocturnal frequency generally believe that it is common to all men of advancing years Frequency in men past 50 may be a sign of prostatic enlargement obstructing the urinary bladder and causing inflammatory reactions In the younger individual, it may be a sign of tuberculosis of the kidney. In women it may be the sign of onset of acute cystitis

From a clinical standpoint, we do not consider as extremely important the frequency which occurs only in the waking hours but does not disturb sleep. Whenever urination is necessary oftener than every hour in the day or more frequently than twice a night, the causes should be thoroughly investigated.

Dysuria—Strangury and tenesmus are terms which were greatly favored by all the older writers on genito-urinary diseases Strangury is defined as a spasmodic endeavor to empty an inflamed bladder which usually results in a drop-by-drop evacuation. Tenesmus may be defined as a straining to empty the inflamed bladder without the outflow of urine Frequency, dysuria and difficulty are often present at the same time, for they commonly stem from the same disorders or diseases

Polyuria—Polyuria means a great increase in the amount of urine If increasing amounts are passed day after day, this suggests diabetes insipidus, due to disease of the pituitary gland. Mere ingestion of large quantities of water will produce polyuria

Oliguria and Anuria—Oliguria and anuria are closely related. Sudden diminution of the amount of urinary output may be a serious sign. Sometimes in the course of various types of disease, the amount of urine suddenly diminishes although the intake is apparently sufficient. When the amount of urine is diminished to 200 or

300 cc. output per day anuria or total suppression of urine may be impending.

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not enuresis in the true sense, it is mistaken for the true disease One should not dismiss enuresis as a conduct disorder without thoroughly examining the patient to discover if an anomaly is present If, after a thorough examination, nothing is found, enuresis can be classed as a conduct disorder and then belongs more in the realm of the neurologist than in that of the urologist Enuresis and its treatment are dealt with more fully in Chapter 13

Catheters and Sounds—Their Uses and Dangers

CATHETERS.—Perhaps it only seems to be true that most of the acute retentions occur at remote places and in the middle of the night. The patient is usually an aged male who must have immediate relief however no age or sex is exempt. Usually the bladder is so distended that it can be palpated at the level of the umbilicus and the patient has been suffering for many hours. It is the practitioner not the specialist, who is most frequently confronted (in the small hours of the night) with this situation.

The doctor (1) must have the proper "tools" to deal with this condition and (2) must know how and what to do. Most of us have known patients who carried their personal catheter in their vest pockets or hat bands and used this completely unsterilized instrument several times daily for many years without apparent bad results. However this is an exception and proves only how tough the human frame is. With a properly developed aseptic conscience, such carelessness cannot be tolerated in our methods or thinking today.

The instruments needed to deal with a case of acute retention of urine are neither numerous nor complicated. The physician should have in his bag, ready and sterilized the following (1) an assortment of catheters—soft rubber ordinary 15 or 16 F size soft rubber with Coudé tip 15 or 16 F size woven catheter with Coudé tip a
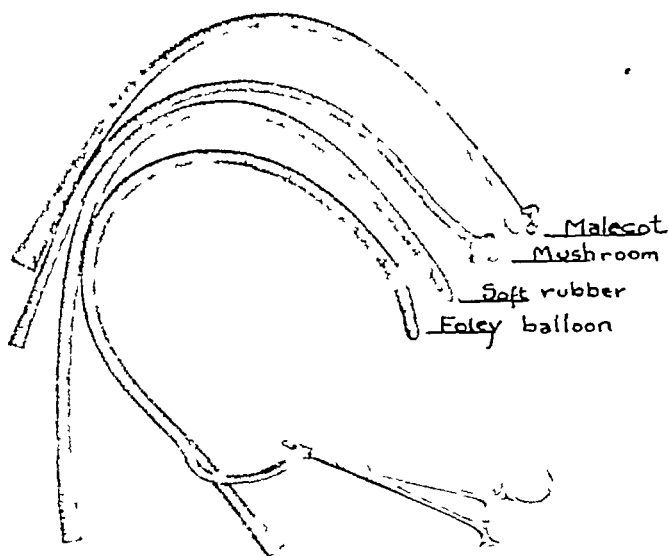
FIG 12 —Catheters, reading from top down four-winged Malecot, mushroom, ordinary soft rubber, Foley balloon (the balloon, when inflated, holds the catheter in the bladder)

5 cc Foley balloon catheter, (2) a thumb forceps or Kelly hemostat, (3) dry cotton balls, (4) a supply of water-soluble lubricant, K-Y or similar lubricating jelly, (5) alcohol, (6) a large bottle or container in which to collect urine

TECHNIC IN THE MALE

1 The instruments are laid out on a sterile towel

2 The meatus is cleansed with soap and water and then with alcohol

3 A sterile towel is laid above and below the penis

4 A small quantity of lubricant is laid on the sterile towel

5 The hands are scrubbed thoroughly

6 The catheter is picked up with the sterile forceps, grasped about 2 in from the end The outer end of the catheter may lie on the sterile towel or may be looped between the fingers (Woven catheters, which are stiffer than rubber ones, may be grasped with the fingers on the outer end)

7 The end of the catheter is then passed through the lubricant

8. Standing at the patient's left side (if you are right handed) the penis is grasped and held up with the left hand and the catheter inserted into the meatus and pushed into the urethra with the forceps, being careful not to touch the forceps to the meatus. The forceps is then placed 2 in. back on the catheter and the catheter again fed down into the urethra.

9 When the catheter tip reaches the sphincter in the membranous urethra (the cut-off or compressor urethrae muscle) it will stop At this point one should by all means stop the progress of the catheter a moment to wait for the muscle to relax, then push the catheter down into the bladder when the flow of urine will begin.

10 In cases of stricture of the urethra, the catheter will pass no farther than the obstructing stricture and something else must be done.

11 In case of hypertrophied prostate the angulation of the enlarged and distorted gland is next met with. If the ordinary soft rubber catheter cannot make the turn around the almost right angled bend in the prostatic urethra, the Coude catheter must be tried this will usually pass.

If the patient's bladder has been greatly distended for a long time, it is much better and safer not to drain off all the urine at one time in other words, decompress the bladder take off only enough urine to make the patient comfortable. One should not make the error of withdrawing the catheter in the expectation that the patient will void normally· the chances are that the physician will have to return in a few hours to repeat the catheterization, so the catheter should be fastened in the urethra in the first place. To do this, the catheter is secured with adhesive strips. First, five strips of adhesive tape about ¾ in. wide are prepared four of the strips should be 4½ in. long and one 1½ in. long The next step is to dry the penis and the part of the catheter to which the adhesive strips are to be secured. Then three of the long strips are placed to secure the catheter to the penis and the short strip is wound around the other ad

hesive strips and the catheter close to the meatus The remaining long strip is first looped and stuck together to form a flat loop, then this is fastened around the shaft of the penis over the longitudinal adhesive strips, the purpose of this loop being to take care of any expansion in case of an erection.

To decompress the patient's bladder, a notch is cut in the side of an ordinary wooden golf tee and the tee is boiled This tee is placed in the end of the catheter, and a drop-by-drop flow will gradually decompress the bladder in a few hours One should make sure that it will drip faster than the flow from both ureters—120 drops a minute is about right Another tee, without a notch, should be at hand to plug the catheter, to use later The patient can then empty his bladder by simply removing the plug The patient can and should be up and about. If the physician has one of the balloon catheters with a 5 cc capacity balloon and if this will pass into the bladder, no adhesive strips are necessary since the balloon when inflated with 5 cc of water holds the catheter securely in the bladder The patient should be given a sulfonamide, either sulfacetimide or sulfathiazole, 7½ gr three times a day after meals. (For a fuller discussion of sulfonamide therapy, see Chapter 20.)

CATHETERIZATION IN THE FEMALE

This is not essentially different from male catheterization. It is most commonly done (and sometimes badly) by student nurses Actually, it is more difficult to catheterize the female aseptically than the male The necessary equipment is the same as for male catheterization.

1. The vulva is cleansed with soap and water Instead of alcohol, an aqueous antiseptic like 1 5,000 merthiolate solution is used.

2 If the patient is of a nervous temperament, a cotton applicator dipped in lubricant containing a local anesthetic, such as metycaine 4 per cent, is placed in the urethra before passing the catheter

3. It is seldom necessary to decompress the female bladder even when it has been distended for a long time

4. The catheter is grasped with the forceps, the tip of the catheter dipped in the lubricant and passed through the urethra into the bladder. If it is necessary to leave the catheter in the urethra to drain the bladder it is better to use the balloon catheter or a four wing Malecot catheter

5 The same arrangement for periodic emptying can be used as in the male. The golf tee serves well here also.

So far we have said nothing about metal catheters There is no more wicked and dangerous instrument in all surgery than the curved metal catheter whether made of pewter brass, nickel silver or gold, it is a completely unnecessary instrument. A woven Coudé catheter will pass anywhere that a metal one will pass and will do so safely The danger with the metal catheter is in creating a "false passage. This means that the catheter has punctured the urethra and is traveling along in the tissues beside the urethra. It can readily be seen how this can come about when one considers the distortion of the prostatic urethra produced by certain prostatic enlargements. When a false passage is made beside the urethra it becomes difficult, even for an expert, to insert any sort of catheter into the urethra and have it reach the bladder Inflammatory processes are set up which may end in infection and death. We have seen literally scores of such cases. Sometimes the only solution is to establish suprapubic drainage of the bladder and insert a suprapubic tube When the urine is thus diverted, one can safely wait until the inflammatory process subsides and then undertake surgery of the prostate.

Not quite as bad, but still dangerous, is the curved re-enforcing stylet which is used to stiffen the catheter and curve it to the urethra. We have seen this become an instrument of death also The tip of the metal guide on the stylet is apt to slip out of the catheter eye and penetrate the side of the prostatic urethra, often entering the prevesical space

Metal catheters for females are too dangerous and are completely unnecessary Sometimes in skilful hands a combination dilator and female catheter can be used. In some hospitals, glass catheters are

in daily use This is unspeakable folly We can quite understand
that a doctor who is gentle and skilful may get along using a glass
catheter on his female patients for years with no untoward happen-
ing, but to allow student nurses to catheterize female patients rou-
tinely with glass catheters is simply inviting trouble

FILIFORMS —These instruments were invented by the French It
is used principally for passing through a stricture of the male
urethra Lord Lister said that before attempting to pass a filiform
through a stricture the bowels should have moved well that morn-
ing (and he meant the bowels of the physician) This is a true esti-
mate, for this seemingly simple procedure requires extreme patience
and skill Two or three good spiral-tipped filiforms with male thread,
with the proper bougies and catheters which screw fast to it, should
be in the emergency bag of every practitioner One good spiral-
tipped filiform is worth a dozen straight ones

When the filiform has passed through the stricture, the follower
or bougie or catheter is screwed securely to it The next maneuver
is not so simple To get the filiform to guide the follower into the
bladder without crumpling requires skill It is accomplished by
alternately pushing and pulling A gentle push is given the follower,
and one can feel the filiform gently move forward Then a little
pull straightens the filiform, but the pull is not as long as the push
When the bougie or catheter engages the stricture this can be defi-
nitely felt When the catheter with the filiform attached comes out
in one piece on removal, the novice may breathe a sigh of relief
To screw one of these filiforms to a metal follower and get it to
pass into the urethra is a maneuver fraught with all the dangers of
the metal catheter

SOUNDS AND BOUGIES —No sound smaller than a number 21
should be in the kit of the general practitioner Sounds of larger
caliber are much safer than smaller ones It used to be considered
good practice to pass sounds in patients with acute gonorrhea or
those just recovering from it Today no such dangerous and meddle-

some treatment is countenanced. It would be much safer to discard metal sounds and use only flexible bougies.

When the practitioner has learned what he can safely do in the way of urethral instrumentation and what he should not attempt, he has become a wise doctor

Infections of the Kidney

(Exclusive of Tuberculosis and Gonorrhea)

WHEN INFECTIONS of the kidney are discussed, the practitioner is apt to think immediately of pyelitis More has been written about pyelitis than of all other infections of the kidney The term 'pyuria" is often used as if it were synonymous with pyelitis, but nothing could be further from the truth

The modern physician attempts to determine the etiologic organisms whenever an infection is encountered anywhere This is not always easy in urologic infections. Most of the time, however, a stained smear of the urinary sediment offers a short cut to the correct diagnosis If the invading bacteria cannot be found by this simple method, the longer and more exacting culture methods must be resorted to

The full list of bacterial agents that have been isolated from the urinary tract includes a confusing number However, most of the mischief is caused by relatively few types of bacteria There are, as is well known, two great groups of organisms (1) the gram-negative and (2) the gram-positive. In the first group is Bacillus coli communis, known also as Escherichia coli In this group, too, are the gonococcus and Micrococcus catarrhalis, Bacillus lactis aerogenes, also known as the aerobacter, is frequently mentioned, and pyocyaneus. proteus, typhoid and paratyphoid bacilli less commonly Among the gram-positive group are the two staphylococcic mem-

bers, albus and aureus, and many strains of streptococcus. Less frequently seen are the pneumococcus groups. For a complete discussion of the bacteriology of kidney infections, the reader is referred to standard works on bacteriology

How organisms arrive in the kidney to set up infection is both interesting and important. While some phases are still controversial, many proved facts are available. The three routes of invasion are (1) urinary or urogenous (2) blood stream or hematogenous, and (3) lymphatic, or lymphogenous

In the urinary route, we find many practical explanations of the whole mechanism. Frequently and especially in the female the first symptoms are referred to the bladder It is common to obtain a history first, of urethral disturbance, then bladder distress and next a full blown kidney infection. The practical medical man asks how else infection could occur except that the bacteria come from the outside through the short urethra to the bladder and thence to the kidney by continuity along the mucous surface. Although for a long time this attractive theory was abandoned in women and girls we feel sure that this is a common mode of invasion. In children who are dirty pyelitis is more common than in clean children. It is important that the region of the anus and vulva be cleansed with soap and water every day When this is not religiously done and the child is not taught this important habit early sporadic urethra bladder kidney infections will be common among women of all ages. We have come back to believing then, that the urinary or ascending, route is a real factor in infections of the kidney

The blood stream route accounts for perhaps the larger number of the more serious kidney infections. The usual teaching that the coccus group of invaders always attacks the cortex of the kidney while the colon group always invades the pelvis, has considerable truth but is by no means a fixed or invariable rule There can be no doubt that focal infections play a role in kidney infections. Just where such focal infections reside sometimes becomes a major problem in treatment of the disease The blood stream picks up the

bacteria and carries them to the kidney Not all the arterial blood that goes through the kidney passes through the glomerular tuft, some of it supplies the interstitial portion of the kidney The velocity and volume of blood flow through the kidneys are definite factors in causing renal infections

Invasion by way of the lymphatics is second in importance to the blood-borne infections Just how and by what mechanism this comes about is not entirely agreed on We had our attention called to this route in some experimental work on the various methods of uretero-intestinal anastomosis One study involved the placing of a small loop of intact ureter within the lumen of the bowel The continuity of the ureter was in no way broken and urine still flowed into the bladder We were greatly interested to note that infection ascended to the kidney by way of the lymphatics surrounding the ureter The infection did not enter directly into the kidney but first invaded the perirenal lymph nodes and then the kidney We know from this experiment that the kidney pelvis and parenchyma can and do become infected in this manner

It has been shown by a number of experimenters that India ink injected into the cervix of rats, rabbits and guinea-pigs is carried to the lymphatics of the broad ligament and thence by way of the net-work of lymphatics surrounding the great vessels to the lymph nodes of the kidney Also, the theory that bacteria are carried by the lymph system to the thoracic duct, from which they enter the general circulation of the blood, may have considerable foundation in fact. If this is true, kidney involvement may be considered a combined lymph- and blood-borne infection

Pyelitis and Pyelonephritis

The possible routes of invasion being clear, it is appropriate to discuss briefly the pathology of the kidney attacked by the bacteria in question. The clinical manifestations of the disease will be considered according to their characteristics in three types of patients—men, women and children

It was Rayer who, in 1843 originated the term "pyelitis" He wrote that the disease is not confined to the pelvis of the kidney but promptly attacks the parenchyma, or conversely if it originates in the parenchyma, it quickly spreads to the pelvis. Pyelonephritis is not a combination of nephritis and pyelitis. Pyelitis and pyelonephritis result from direct invasion of the kidney by bacteria, while nephritis, for the most part, is caused by the toxins of bacteria passing through and injuring the kidney while the bacteria themselves may be located at a distant point in the body

In acute pyelitis only one kidney may be involved. The disease attacks the mucous lining of the pelvis of the kidney resulting in inflammation and edema. The edema may result in obstruction of the ureter at the ureteropelvic junction, thus laying the groundwork for severe systemic manifestations. If the pathologist sees a specimen at this stage, he can describe it as acute for the area will be infiltrated with polymorphonuclear leukocytes instead of round cells. Actually that is the substance of the pathology of pyelitis despite the volumes that have been written about it.

Acute pyelonephritis either can come about as an extension of any acute pyelitis or can be directly planted in the cortex and start as full-blown acute bacillary pyelonephritis. How does this acute pyelonephritis differ from nephritis, or Bright's disease? In Chapter 4 we endeavor to make clear the pathology of nephritis. In pyelonephritis it is the tubular area which suffers most from the suppurative process. The glomeruli and glomerular tufts are rarely affected by the bacillary invasion. On the other hand, the coccus groups, notably the staphylococcus, invade the glomeruli and produce on the surface of the kidney beneath the capsule scattered or grouped minute lesions which are purulent foci. In acute cases these are filled with staphylococci and surrounded by polymorphonuclears. Such a coccic invasion of the kidney can cause severe systemic disturbance. It may be unilateral or bilateral.

From this point pyelitis may either disappear or become chronic. The same is true of pyelonephritis. Chronic pyelitis is almost always

amyd) in doses of 4 Gm a day should be given Two 7½ gr tablets are given four times a day—three times a day after meals, and at bedtime Penicillin, in doses of 25,000 units every three hours for 200,000 units or more, should be given in conjunction with sulfonamide therapy.

TREATMENT OF CHRONIC PYELITIS OR CHRONIC PYELO-NEPHRITIS —In chronic pyelitis or pyelonephritis the disease has been present over two months Rest in bed is not as important as in the acute stage Diagnostic measures, such as cystoscopic and roentgen examinations, are necessary to prove that the disease is really located in the kidneys

Medication with appropriate chemotherapy is necessary. Sulfadi-azine or sulfathiazole in 7½ gr doses four times a day is usually adequate When it becomes necessary to continue medication for a considerable period, intermittent treatment is of value On such a regime, a sulfonamide is given in 7½ gr doses four times a day for four days, discontinued for a week and then another four day course given During the entire time the patient is ordered to drink 2,500–3,000 cc. of fluids each 24 hours Penicillin, when given, should be given intramuscularly in doses of 20,000 units every four hours until 200,000 units have been administered.

In some cases lavage of the kidney pelvis with silver nitrate solution by means of a ureteral catheter is indicated To do this, a no 6 ureteral catheter is passed to the affected kidney The catheter usually just enters the kidney pelvis when the 25 cm. marks show at the ureteral os in the bladder A 2 cc syringe is filled with 2 per cent silver nitrate solution and the solution is injected into the kidney pelvis through the ureteral catheter After two minutes the fluid is allowed to run out, and 2 cc normal saline solution is injected and the ureteral catheter withdrawn.

When all the pus has disappeared from the urine, the patient should not be considered cured, for recurrence is the rule It is in the interval between attacks that attention should be given to focal infections Examination of tonsils, teeth, sinuses and gallbladder,

and search for diverticula, prostatitis or any other possible focus of infection should be made. Skin lesions such as pimples, boils rashes and paronychia should not be overlooked as a possible source

Attention should be paid to general health. Sufficient rest, plenty of sleep and adequate balanced diet should be made a routine with the patient. If possible the patient's body should be exposed to direct sunshine daily In winter the alpine lamp may be substituted

If hemoglobin content is low any one of the various liver and iron compounds should be given. As a routine to be kept up almost indefinitely the patient should take before breakfast each morning one multivitamin capsule or tablet.

TREATMENT OF PYELITIS IN MEN —There are two cardinal principles in treatment (1) drainage, and (2) antisepsis. Drain age may be done by catheter both ureteral and urethral At times it may have to be by open surgery Drainage is aided by the flushing action of forced fluids.

PYELITIS AND PYELONEPHRITIS IN WOMEN —*In Pregnancy*— It is estimated that the incidence of diagnosis of so-called pyelitis and pyelonephritis in pregnant women varies from 2 to 20 per cent, depending somewhat on the keenness of the medical attendant and somewhat on local conditions.

It is probable that every pregnant woman has a dilatation of the ureters and kidney pelves during the course of her pregnancy This fact is not sufficiently recognized. This has been demonstrated to be a hormonal manifestation occurring regularly during pregnancy In a small series of rhesus monkeys, Van Wegen and Jenkins observed that dilatation of the ureters during the fourth, fifth and sixth months of pregnancy was rather the rule. The ureters do not dilate during pregnancy in the hog cat guinea pig, rat and cow It would seem, then, that dilatation of the ureter during gestation is peculiar to the human race and monkeys.

Stasis of urine as a result of dilatation of the ureters invites infection. When infection develops in any part of the urinary tract, it rapidly spreads to all parts of it. In the primipara this complication

usually develops between the fifth and the sixth month, while in most multiparas the infection develops from the seventh to eighth month, although this is not an invariable rule

The value of the stained smear of the sediment in diagnosis can not be overemphasized Examination of wet sediment under the

FIG 13 —Pyelitis of pregnancy Ureters dilate in all pregnant women With infection, the condition is called pyelitis of pregnancy, apparently infection is incidental, not the primary cause (See also Fig 14)

microscope is also helpful, but only as a preliminary to examining the stained smear Cultures should also be taken, but these require time It is important to remember that only catheterized urine specimens from women are of any value, voided specimens may be totally misleading

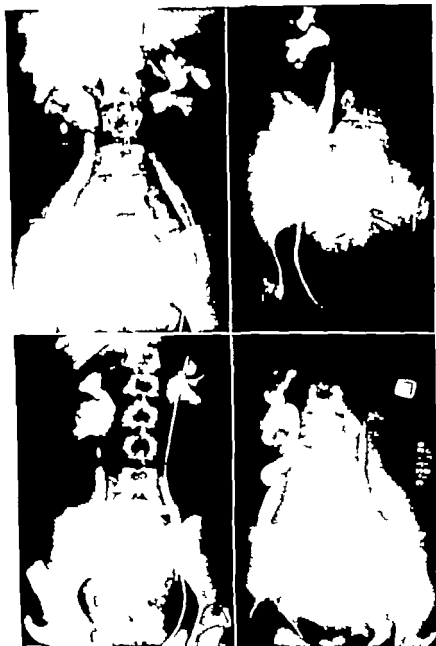In over two thirds of the cases observations of the stained smears

Fig. 14.—Pyelitis of pregnancy (See also Fig. 13.)

of sediment agree with the results of cultures It is possible that a pyelitis of childhood may be relighted during gestation Also pyelitis of pregnancy may recur in succeeding pregnancies and may be carried in a chronic form throughout life This may result in chronic pyelonephritis and may lead to a number of degenerative kidney changes in later life

A discussion of the symptoms and signs of pyelitis in pregnancy is of no value here Generally the obstetrician discovers pus or bacteria in the urine long before the patient complains of any disturbance because every obstetrician now regularly examines the urine of all his pregnant patients The development of malaise, loss of weight, diminution of hemoglobin content, fever, fatigue, loss of appetite or any of the signs common to many diseases should indicate a special examination of the urine The absence of pus in the urine may not rule out pyelitis or pyelonephritis Bacteria in the urine without pus may be the early sign of an imminent infection Repeated daily examinations thereafter will reveal the pus

Prophylaxis of Pyelitis and Pyelonephritis of Pregnancy—The history of previous urinary infections is important in the pregnant woman Care of the teeth should be a routine of general prophylaxis for the pregnant woman, for the old saying, "for every child a tooth," is not without meaning By care of teeth is meant not only daily cleansing and brushing but frequent inspection by a dentist to ward off possible caries, infections, pyorrhea and root pockets Attention to the bowels is advisable so that constipation never occurs Also the patient should be getting a balanced diet. Proper water intake is important In hot weather more fluids are needed than in cold weather In hot climates or hot weather the intake should be 3,500-4,000 cc daily In colder weather, the intake may be reduced to 2,500 to 2,700 cc daily It is to be remembered that unlimited fluid intake, i e , over 3,500 cc daily, for a considerable period may be definitely injurious Proper amounts of rest, both day and night, must be insisted on Proper posture, which becomes increasingly important as the pregnancy progresses, should be taught

The upright position in the pregnant state is not conducive to proper drainage of the kidneys.

Treatment during Pregnancy—Once pyelitis or pyelonephritis has developed, treatment calculated to drive out the infection should be instituted. There are two cardinal principles in the treatment of kidney infections (1) administration of antiseptic drugs and (2) drainage.

It is profitless to discuss the treatments of the past such as alternate alkalinization and acidulation, mercurochrome hexylresorcinol, pyridium hexamethylenamine, arsenicals mandelic acid, ketogenic diets and the like. They are for the most part completely useless. No sane obstetrician would subject his patient to the risks of a ketogenic diet.

At the sign of bacteria in the urine the patient should be given a sulfonamide. Which compound is best depends somewhat on personal judgment. We favor sulfacetimide. Its low toxicity and, to a large extent, freedom from reaction recommends it to us. We have never had a case of anuria or blockage of the kidney from its use Sulfathiazole or sulfadiazine may be used. A four day course of 7½ gr doses (0 5 Gm.) three times a day after meals is effective. Dosage for penicillin should be 20 000 units every four hours until 200 000 units are given.

Some persons are sensitive or allergic to the sulfonamides and penicillin. At the first sign of a reaction the drug should be stopped and large quantities of water given. It appears not only that a person once sensitized to the drug is always sensitized but also that she may be sensitized to any or all of the various compounds. Unfortunately this is not a rare phenomenon since it occurs in about 15 per cent of cases. Intravenous urograms usually disclose dilatation of the ureters and kidney pelves, because in women of childbearing age the kidneys are usually sound. It is wise first to take a preliminary or scout plate to see whether there is any tendency to calculus formation in the kidney

A sulfonamide or penicillin usually clears the kidney infection,

but it may promptly return In a few cases it may be necessary to use an indwelling ureteral catheter to drain the offending kidney Sometimes symptoms such as fever to 107 F and chills, with a high leukocyte count, cannot be controlled by the sulfonamides and penicillin alone and a urologist must be asked to place an indwelling ureteral catheter Not more than five to seven days of such fever and chills should elapse before cystoscopic intervention

Formerly all septic patients—with fever, chills and leukocytosis in whom the kidney could be palpated as a tender mass—were subject to nephrostomy Such treatment is rarely used now and indeed is rarely necessary If a nephrostomy were done in a pregnancy and there was a flare-up in the same kidney in a succeeding pregnancy, the surgeon would hesitate to repeat the operation, for after several nephrostomies the kidney would not be worth saving

In the Nonpregnant Woman—Pyelitis and pyelonephritis in nonpregnant women differs little from pyelitis and pyelonephritis in men and children except that it is often overlooked If, as happens many times, the onset occurs with acute cystitis, the patient goes to her doctor for relief Otherwise she waits and suffers for a few days until the bladder symptoms disappear By that time, the disease is firmly established in the kidney or kidneys

It is important to investigate thoroughly and treat carefully every patient with cystitis, for the infection probably is either the beginning of pyelitis or the signal of pyelonephritis It is perfectly proper for the practitioner to make a cystoscopic examination of such a woman in the office provided it is not done during the acute stage Interpretation of the cystoscopic appearance of the bladder requires a lot of experience However, even the most inexperienced cystoscopist can see inflamed bladder mucosa If study of the normal bladder mucosa has properly impressed the examining physician, he can easily detect deviations from the normal Usually, it becomes immediately evident that the zone of redness extends upward on the bladder wall from the internal urinary orifice, marking it as an ascending infection from the urethra

The following *treatment* is valuable to combat the disease in the early stage. The bladder is emptied with a catheter and 10 cc. of a 1 1 000 solution of nupercaine is instilled in the bladder. This is allowed to remain in the bladder with catheter clamped for 10 minutes and then permitted to flow out. Next 10 cc. of a 10 per cent neosilvol solution, to which has been added 5 drops of a 2 per cent silver nitrate solution is instilled into the bladder and the catheter withdrawn.

This program of local treatment should be carried out daily for three or four days, at the end of which the patient should be free from bladder symptoms. Treatment, especially if immediately and dramatically effective, should not be continued longer than a week.

The patient should also be given a sulfonamide three times a day. The urine should be examined daily and when it is free from pus cells and bacteria, the sulfonamide is discontinued.

Pyelitis of the Marriage Bed (Honeymoon Pyelitis).—This little recognized type of kidney infection should be called to the attention of every practitioner. It is not the seriousness of the disease itself which needs emphasis but the capacity of the disease for stirring up social complications embarrassing to everyone concerned.

Four or five days after marriage the bride develops full blown pyelitis. Urinary frequency is apt to be present. Swelling and edema of the parts are sometimes present owing to the efforts at copulation. The bride tells her mother and her mother tells her father and sometimes a doctor is involved. The groom is at once suspected of having a "bad disease" notably gonorrhea. We have known of serious consequences resulting such as annulment of the marriage or what is sometimes worse complete loss of confidence in the husband by his young wife. To recognize this disease as "honeymoon pyelitis," as it is sometimes called, is well worth the trouble. Only a wise and experienced physician can deal properly with the disease and the family and patiently explain the whole condition. The treatment is the same as for pyelitis in nonpregnant women.

PYELITIS AND PYELONEPHRITIS IN CHILDREN.—It is sometimes

suggested that pyelitis of pregnancy is merely an exacerbation of an attack of pyelitis in childhood This, of course, is difficult to prove If true, then the pyelitis of childhood is not pyelitis at all, but pyelonephritis and a serious disease well worth study and attention

Since most of the diseases of childhood, such as diphtheria, scarlet fever, measles, typhoid fever and smallpox, have been placed under control, pyelitis and pyelonephritis, although not contagious diseases, now far outnumber all other bacterial diseases in children of the diaper age—2 years and under

One is impressed, after examining the urine in a large number of patients with juvenile pyelitis, by the small number of pus cells per cubic millimeter in proportion to the systemic disturbance This confirms the idea that within the kidney parenchyma are locked minute foci of the infection Because of the pressure under which the bacteria and their toxins work in so vascular and vital an organ, the systemic effect is severe

It is easy to account for such signs and symptoms as fever, temperature up to 107 F , chills, vomiting, diarrhea, high leukocytosis, weakness and convulsions when these simple pathologic facts are kept in mind The pathology, in general, is the same as that described earlier in this chapter As a rule, acute pyelitis in children has a severe onset Symptoms clear up in a few days, although some last a week or two Relatively simple remedies are credited with the cure in these cases because of the tendency to self-limitation

The persistent, recurring or chronic cases present the greatest problem in management It should be recalled that congenital anomalies of the urinary tract are fairly common, and such anomalies characteristically cause stasis of the urine either by atony or by obstruction (These anomalies are dealt with in Chapter 10) It is well to make a search for an obstructive anomaly in every case of persistent pyelitis in a child

Respiratory infections, infected tonsils and constipation are probably the three most important causative factors in pyelitis of childhood Pyelitis and pyelonephritis frequently persist as a complication

following infectious diseases and, as such must be reckoned with.

Treatment—The correction of constipation and tonsil and respiratory infections should, of course, be undertaken at the proper time as part of both cure and prevention. To recite all the various treatments used in the past is vain repetition. Ketogenic diets are a particularly barbarous form of torture for little folk and, in view of our newer concepts, quite useless. The production of ketones in the urine by diet was instituted for the purpose of producing such a low pH of the urine as to kill bacteria. Mandelic acid will accomplish the same effect but is not easily administered. It is generally recommended that it be given in large doses with restricted water intake. But to restrict fluids in kidney infections is not usually wise. Some preparations of mandelic acid are said to be fairly palatable but we have never tasted any of that variety.

The advent of the sulfonamides, together with penicillin and streptomycin, has made obsolete all other forms of urinary anti sepsis. The sulfonamides will usually kill both bacillary and coccic forms in urine. Sulfathiazole sulfadiazine or sulfacetimide should first be given in appropriate doses. Tolerance of the patient to the drug differs widely hence there can be no fixed or invariable dosage. Not infrequently a marked curative effect is obtained after the first few doses. Blood concentrations do not seem to matter as much as we are led to believe. The best method of administering a sulfonamide in our hands is to give an initial large dose. This may vary according to the age of the child of sulfacetimide, sulfadiazine or sulfathiazole 5 gr for a child a year old to 22½ gr for an older child. Following this, one half of a 5 gr tablet is given three times a day for four days to the younger children and larger doses to the older ones. After a sulfonamide has been discontinued for four to 15 days and is then administered again, about 15 per cent of patients have a severe febrile reaction. This reaction may be mistaken for onset of some serious disease if the doctor is not aware of this vagary of the drug. If the sulfonamide or penicillin does not clear the pus from the urine and virtually cure the patient in four days,

further investigation should be instituted to restudy the cause
There may be other pathologic changes in the urinary tract, such
as stone, tuberculosis, tumor or a congenital anomaly

Coccic Infections of the Kidney (Except Gonococcic)

We now come to the consideration of an important but often
unrecognized disease entity To explain this disease, such terms as
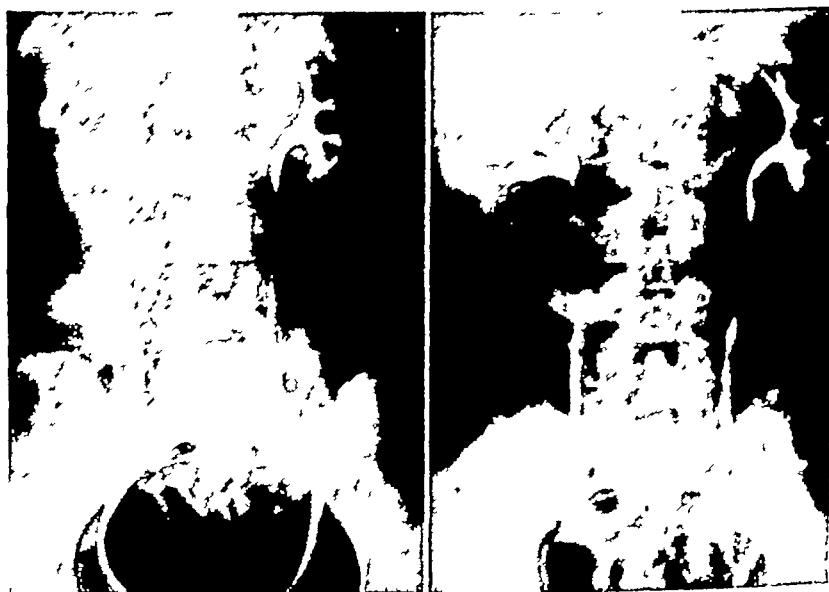
FIG 15 —Staphylococcic infections *Left,* acute infection of right kidney in girl,
20 Infection and resultant edema closed the renal pelvis Temperature was
104 F , with chill, leukocyte count 28,000 She recovered without operation
Right, renal carbuncle Part of kidney was removed with mass of infected
material resembling carbuncle on the surface of the body, from which this
was a metastasis

coccic kidney, carbuncle of the kidney, cortical abscess, multiple
septic infarcts of the kidney and Brewer's kidney have been invented
by various writers during the past 40 years The diagnosis rests on
fever, leukocytosis and clear urine The history will reveal a skin
infection such as paronychia, impetigo, furunculosis or carbuncle
The disease is metastatic in most instances The cocci arrive at the
kidney cortex by way of the blood stream The cocci deposited thus

in the kidney cortex form minute abscesses which may coalesce to form larger ones. If abscesses rupture on the surface of the kidney they become the starting point of perinephritic abscess. Carbuncle of the kidney derives its name from the fact that grossly the condition resembles a carbuncle on the surface of the body

The urine, though macroscopically clear may show various groups of cocci in the stained sediment. Recognition of the early manifestations of the disease is important, for it is then that the sulfonamides or penicillin can abort or cure it. Many acute cystitis attacks in women are due to these bacteria and if not promptly and adequately treated will result in an infection of the kidney by one of the cocci.

Once the condition is suspected a urologic examination should be made, but such instrumentation should not be done during the first few days of the acute stage. Pyelograms will demonstrate a typical deformity of the kidney pelvis. There will be, in most instances, a curvature of the spinal column with the concavity toward the affected side. There may also be an obliteration of the shadow of the edge of the psoas muscle The chronic forms of coccic infections of the kidney may drag on for many months.

If the sulfonamides, penicillin or streptomycin do not cure promptly drainage of the affected kidney by incision is necessary

Perinephritic Abscess

Until recently the formation of a perinephritic abscess was not fully understood. Because of that misunderstanding, it is necessary to consider it under a separate heading Perinephritic abscess always arises from an abscess originating on the surface of the kidney usually beneath the capsule This small abscess ruptures into the perirenal fat capsule and sets up a new infection. The kidney itself often recovers from its infection, so that the new disease, the perirenal abscess seems to be the primary disease.

The clinical picture of perirenal abscess is one that every practitioner should have clearly in mind. Study of a large series of histories showed that the average time between the onset and the

correct diagnosis was four and one-half months The onset is often insidious, and most early manifestations are ignored by the patient and he does not go to a doctor

Formerly, after the disease was established the persistent remitting type of fever led to diagnosis of typhoid fever Examination of the blood will reveal first a lowered hemoglobin content, next an increasing leukocyte count from 13,000 to 50,000 per cu mm After a few days the patient will begin to complain of pain in the side, usually in the costovertebral angle The whole picture should lead one to suspect perinephritic abscess By the time there is bulging in the back on the affected side, the diagnosis is clear to everyone

Roentgenograms usually show a mass in the area of the affected kidney, with obliteration of the shadow of the psoas muscle and a curvature of the spine with its concavity toward the affected side

Treatment includes incision and drainage of the kidney If the kidney is badly diseased, nephrectomy may also be indicated A few cases have been reported cured by large doses of penicillin At least 50,000 units of penicillin every four hours should be administered for a full week, for a total of 2,000,000 units However, when a palpable mass is present, incision and drainage should be performed Sulfonamide or penicillin therapy is important in the recovery period

Pyonephrosis

As its name implies, pyonephrosis is a kidney filled with pus Pathologists do not agree on what is meant by pyonephrosis, so it is not strange that clinicians do not agree either

There are various causes of such a disease Obstruction by a stone impacted in the ureteropelvic junction may cause it When a mass of calculi in the kidney is responsible it is called calculous pyonephrosis The kidney may be the seat of multiple small abscesses which may coalesce to cause pyonephrosis It is a serious destructive disease of the kidney, and treatment is surgical removal

4

Nephritis

NEPHRITIS, OR Bright's disease has long been a subject of interest, attested by the volume of literature on diseases of the kidney which are due to damage from toxins brought to it by the blood stream. We discuss here some general divisions of this complex problem, knowing perfectly well that we cannot in one chapter cover the subject fully

We have not discussed the pathology of the kidney in each type from the dead house point of view but have rather considered the clinical aspect as it relates to damage to the kidney Nephritis is readily differentiated from the infections of the kidneys discussed in Chapter 3 which are the result of direct bacterial invasion. In nephritis the changes appear to be the result of indirect injury by extrarenal bacterial toxins, or by products, or the result of chemical or metabolic injury The clinical manifestations of nephritis are clear and are shown mainly by the presence in the urine of by products of degenerative processes, namely casts, albumin and blood, and sometimes by such signs as a rise in blood pressure or edema. Usually pus cells are not abundant in uncentrifuged urine. Thus, in itself is of diagnostic importance in differentiating this group from the so-called infectious processes

The classification of nephritis is based on the portion of the kidney primarily affected. However most lesions of nephritis are not limited to a single portion of the kidney substance mixed types of lesions, therefore, often occur Nephritis may be sub-

divided into   (1) glomerulonephritis (also called hemorrhagic nephritis), in which the injury is primarily in the glomeruli, (2) nephrosis (also called tubular nephritis or albuminuric nephritis), in which the injury primarily affects the tubules, and (3) sclerotic nephritis, in which the disease primarily affects the blood vessels

Glomerulonephritis (Hemorrhagic Nephritis)

Glomerulonephritis may be divided into
1 Focal glomerulonephritis
2 Diffuse glomerulonephritis

In focal glomerulonephritis only some of the glomeruli are involved, whereas in diffuse glomerulonephritis all the glomeruli are affected When all are involved, the symptoms of renal insufficiency predominate and death may occur, in focal glomerulonephritis there are few signs of renal insufficiency and prognosis is good

FOCAL GLOMERULONEPHRITIS (FOCAL HEMORRHAGIC NEPHRITIS) —This occurs particularly during streptococcic infections, including diseases of the upper respiratory system such as the common streptococcic sore throat, streptococcic tonsillitis, otitis media, scarlet fever, erysipelas, acute endocarditis, rheumatic fever, purpura haemorrhagica, septicemia and wound infections Typhoid fever, diphtheria and influenza are rarely responsible Subacute bacterial endocarditis of Streptococcus viridans origin is regularly associated with focal glomerulonephritis

Symptoms and Diagnosis —Gross blood in the urine is the predominant complaint. The urine may be frankly bloody or may be reddish-brown or pink The gross hematuria is not always constant, but microscopically some red blood cells may be found in the urine at all times Pain in the costovertebral angle occurs in about one fourth of the cases In addition to blood in the urine, albumin is present in moderate amounts There are a few white blood cells and both hyaline and granular casts There is little, if any, demonstrable diminution in renal function, no rise in blood pressure and generally no edema.

Focal glomerulonephritis must be differentiated particularly from diffuse glomerulonephritis in which there are an increase in blood pressure, symptoms of uremia and edema. Focal glomerulonephritis must also be differentiated from other renal lesions, such as tumors, tuberculosis, calculi, varices and angiomas. Lesions of other parts of the urinary tract, such as bladder tumors, prostatic hypertrophy and seminal vesiculitis must not be forgotten. Whenever there is a reasonable doubt, it is important that pyelography be done

Prognosis —The prognosis for focal glomerulonephritis is good. Recovery occurs in one to three weeks. The prognosis is uncertain when focal glomerulonephritis becomes chronic or when repeated attacks occur

Treatment —The treatment in acute focal glomerulonephritis is that of the disease of which the focal nephritis is a complication. Since the streptococcus is generally the causative organism, sulfonamide or penicillin therapy is indicated. When focal glomerulonephritis follows streptococcic tonsillitis, pharyngitis, otitis media, rhinitis or septicemia, penicillin or sulfadiazine are preferred. When it occurs with scarlet fever or erysipelas, sulfanilamide is the drug of choice. We believe that if the primary disease is treated adequately and early with penicillin, in doses of 40 000 units every four hours for the average adult, or with the sulfonamides, in doses of 60 gr a day of one of three sulfonamides—sulfacetimide, sulfadiazine or sulfathiazole—fewer cases of focal glomerulonephritis will be encountered.

Sometimes, however the physician is not called until hematuria has occurred. In these cases we recommend the use of penicillin or of a sulfonamide as may be indicated by the history With recovery from the original disease, the focal glomerulonephritis may and usually does disappear Rest in bed is advisable as long as there is blood in the urine, but it is not advisable to keep the patient in bed for months just because of slight hematuria. Large quantities of water should be taken to help wash out the invading organ

If the patient had pre-existing hypertension, blood pressure may be even higher The rise in blood pressure is the best index of the severity of the disease It will return to normal before the other manifestations of the disease have disappeared

Headache, dyspnea, pallor, nausea and vomiting and, occasionally, diarrhea occur

Examination of the eyegrounds in acute glomerulonephritis shows hemorrhages, edema of the nerve head, narrowing of the retinal arteries and increased filling of the veins

Blood chemistry determinations show the nonprotein nitrogen between 30 and 80 mg per 100 cc, urea nitrogen from 13 to 60 mg and creatinine from 1 to 7 mg The intravenous phenolsulfonephthalein kidney function test shows a total of 25 to 40 per cent excretion in one hour The peak of the excretion is moved over to the third or fourth 15 minute fraction (see p 23)

The white blood cell count in acute glomerulonephritis is increased from 12,000 to 20,000, with a predominance of polymorphonuclear leukocytes In more severe cases anemia may develop

Acute convulsive uremia is common in mild as well as serious cases The convulsion is almost always preceded by intense headache and rather sudden elevation of blood pressure

Diagnosis —The diagnosis of acute glomerulonephritis is based on presence of blood, albumin and casts in the urine, edema, elevation of blood pressure and evidence of renal insufficiency Diagnosis may be difficult if the patient is seen after the acute stage of the disease has passed and only blood and albumin are found in the urine The history is exceedingly important in differentiating the disease from focal glomerulonephritis Diagnosis may also be difficult when onset is insidious It may be necessary to keep such a patient under observation for some time to establish the diagnosis Some difficulty in diagnosis also may occur when acute glomerulonephritis is superimposed on pre-existing essential hypertension. Such a patient might be thought to be in the terminal stage of

chronic glomerulonephritis, except that the urine is fairly well concentrated and the patient eventually recovers.

Course and Termination.—The course and termination of acute glomerulonephritis vary as follows.

1 Most patients with acute diffuse glomerulonephritis recover. Improvement is first shown by an increase in the quantity of the urine and the return of blood pressure to normal. Following this there is a decrease in the nonprotein nitrogen content of the blood and the edema disappears. Blood may still be found in the urine, but it soon disappears if there is no complicating focal glomerulonephritis. Albumin in the urine is the last to disappear If the nephritis is due to scarlet fever the course is usually not only longer but more severe than when it is due to exposure. The usual duration of acute diffuse glomerulonephritis is two or three weeks mild cases may last only a week, and severe cases may last six or eight weeks

2 In some instances there are persistent hematuria and albuminuria owing to a complicating focal nephritis Whenever blood and albumin are present in the urine longer than six to eight weeks, focal nephritis should be suspected and treatment begun. Recovery usually follows removal of foci of infection and administration of sulfonamides in repeated courses.

3 Some patients do not recover from the acute diffuse stage but progress to subacute diffuse glomerulonephritis which is generally fatal in three to six months. The urine output is usually low edema is nearly always present, and blood pressure is 40-60 mm. Hg above normal. The nonprotein nitrogen content gradually increases so that it is soon over 100 mg. per 100 cc. and may reach 400 mg. late in the disease The eye signs in subacute diffuse glomerulonephritis are particularly important they consist of edema and choking of the optic disks with hemorrhages and small areas of exudation in the retina. Hemorrhages may occur elsewhere also, in the skin, conjunctiva and respiratory gastro-intestinal and genito-

urinary tracts The kidneys are unable to concentrate urine No phenolsulfonephthalein will be excreted in an hour when given intravenously Uremic convulsions may occur When true uremia develops there are nausea, vomiting, diarrhea, itching, restlessness, twitching of the muscles and the odor of urine on the breath

4 Other patients pass from the acute stage to that of subchronic diffuse glomerulonephritis which is generally fatal in six months to two years After the acute stage, blood and albumin continue to be present in the urine and the blood pressure remains somewhat elevated In the subchronic diffuse stage the blood pressure gradu ally increases to 160 to 180 mm Hg and later even to 200 mm The diastolic pressure is often 130-140 mm Hg, in contrast to that in renal arteriolosclerosis, in which it is rarely above 100-110 mm

In subchronic diffuse glomerulonephritis the heart is always hy pertrophied The amount of edema varies greatly The urine gradu ally becomes more dilute and toward the end its specific gravity of 1 006 to 1 012 is constant Blood values may be normal for a long time, but gradually the nonprotein nitrogen content becomes elevated The kidney function as shown by the intravenous phenol sulfonephthalein test is gradually reduced When absolute renal in- sufficiency is established, true uremia soon appears

5 Some patients apparently recover from the acute diffuse ne phritis but pass into the stage of chronic glomerulonephritis All signs disappear except the albuminuria, which persists throughout life The patient frequently has recurrent attacks of acute diffuse glomerulonephritis and after many years develops chronic glo merulonephritis with renal insufficiency The process in the kidney is progressive, and two to 25 years may elapse before the termina tion of the disease with renal insufficiency and true chronic uremia

The blood pressure in chronic glomerulonephritis gradually be comes more and more elevated, so that in the terminal stages systolic pressure of 200 to 280 mm Hg and diastolic pressure of 120 to 160 mm is not uncommon Edema at first is variable, but com monly is of cardiac origin or due to lipoid nephrosis

The specific gravity of the urine is low, 1 006 1 010 The blood values in chronic glomerulonephritis gradually show more and more signs of renal insufficiency, the nonprotein nitrogen content may reach 300 mg. per 100 cc urea nitrogen 250 mg and creatinine 21 mg.

Intravenous phenolsulfonephthalein tests show little or no dye excreted at the end of an hour Most patients have anemia. The eyegrounds in chronic glomerulonephritis show radiating lines of exudate around the macula and retinal deposits and may show white deposits of exudate in other parts of the retina Vision is often impaired Itching is common and sometimes there is a frostlike deposit of urea on the skin, usually first seen on the forehead and forearm.

6 A few patients with acute glomerulonephritis die in the acute stage with anuria or oliguria. Some patients die during an acute convulsive seizure, and some die of the original disease.

Treatment —In acute diffuse glomerulonephritis rest in bed is indicated until the acute symptoms have subsided, the blood pressure has returned to normal and the edema and hematuria have disappeared. If the other symptoms disappear and only hematuria persists, further bed rest is not indicated for focal glomerulonephritis is probably then the cause of the persistent hematuria Much has been written about the limitation of protein and salt in the diet in the treatment of acute glomerulonephritis and the addition of carbohydrates and fats to make up the deficit in calories. There is considerable evidence to show that this is actually harmful and that protein is necessary for repair of the damaged kidney

The individual symptoms of acute diffuse nephritis should be treated. If hydrothorax or marked ascites develops the fluid should be removed. After a few days, caffeine in 7½ gr doses every three or four hours should be given. This is the best and safest diuretic. The bowels should be kept well open by epsom salts in doses of 1 tablespoonful twice a day If signs of cardiac failure develop tincture of digitalis in tonic doses of 10 drops, three times a day is

indicated Digitalization is not a desirable procedure in these cases

Impending convulsive states can be recognized by headache pallor, nausea and twitching of the muscles of the hands, feet, face and various other parts of the body which occur before onset. Morphine sulfate hypodermically in 1/6 to 1/4 gr doses may aid in warding off the convulsion, this is a temporary measure and various other controls should be instituted Administration of calcium gluconate intravenously is indicated because lack of calcium may be an irritating factor in these convulsive states Bleeding is helpful This is done in the same manner as when collecting blood from a donor for transfusion The amount removed varies with the patient's condition and may be 500-750 cc In some cases it is important to replace the blood with blood from a healthy donor

If anuria or even marked oliguria develops, administration of hypertonic fluids intravenously in amounts up to 3.000 cc is of decided value The best preparation is 5 per cent glucose in Hartmann's or Ringer's solution Again, it is a question of calling on the kidneys to resume one of their most important functions, that of regulating the osmotic pressure of the organism

If hematuria persists after the acute stage of glomerulonephritis with cystitis, focal nephritis is complicating the picture To find the focus of infection may put the physician to considerable trouble, but he will be well rewarded if successful. The tonsils should be examined, for sometimes tonsils that look perfectly healthy have hidden pockets; therefore, when in doubt, they should be removed The same goes for all other possible foci of infection in teeth, sinuses, lungs, prostate. bowel, cervix and skin.

The management of the subacute, subchronic and chronic forms of diffuse glomerulonephritis is treatment of the symptom complex. Since these diseases are uniformly fatal and since it is thought that the streptococcus is the causative organism, there can be no harm in trying the sulfonamides in small doses It is unwise to use heroic measures in the presence of poorly functioning kidneys, but penicillin in doses of 40 000 units every four hours, or sulfacetimide in

7½ gr doses three times a day for three or four days each week can do little harm and may have value. More effective drugs may be developed, although at present it is thought that the pathologic process is progressive and that such drugs would probably have little effect.

Whenever uremia occurs, whether the patient has an acute subacute, subchronic or chronic form of diffuse glomerulonephritis, treatment should be instituted according to the procedure presented at the end of this chapter

Nephrosis (Tubular Nephritis)

Nephrosis is a term used to designate several conditions in which degeneration of the tubules is the most prominent feature. Albumin in the urine is often marked, and edema is a prominent physical finding.

The subdivisions of nephrosis are

1. Nephrosis of pregnancy
2. Chemical nephrosis
3. Lipoid nephrosis
4. Amyloid nephrosis

NEPHROSIS OF PREGNANCY —This condition is of utmost importance to the general practitioner

Symptoms and Diagnosis —Albuminuria and edema may occur either alone or associated with eclampsia. A few red cells and hyaline and granular casts are found in the urine Edema is common. The blood pressure in milder cases of nephrosis of pregnancy without convulsions may be normal to 180 mm. Hg With convulsions, a sudden increase in blood pressure, even as high as 200 mm. Hg, precedes the attack. The convulsions are of the epileptiform type and are often preceded by prodromal symptoms. Blood values are either normal or only slightly increased with a maximum of 50 mg. of nonprotein nitrogen per 100 cc. Elimination of phenol sulfonephthalein is slightly prolonged.

Prognosis —The prognosis is generally good for usually the pa

tient is young The symptoms ordinarily disappear soon after termination of the pregnancy although in some cases the renal symptoms persist, disappearing later or progressing to chronic glomerulonephritis

Treatment —This should be the same as that given for glomerulonephritis since the object is to restore the function of the tubules

CHEMICAL NEPHROSIS —Chemical nephrosis is most frequently due to bichloride of mercury, often taken with suicidal intent Other heavy metals such as arsenic and the chromium salts as well as phosphorus phenol and oxalic acid may cause nephrosis The poisonous products absorbed from severe burns, certain chronic dermatoses necrotic tumors and syphilis also produce a nephrosis of this type We have seen this type of lesion following the ingestion of lysol Death may result from renal failure caused by chemical injury of the renal parenchyma Kidney lesions vary from simple cellular changes to generalized tubular necrosis with renal insufficiency and anuria.

Symptoms and Diagnosis —The symptoms are those of acute poisoning with nausea and vomiting and sometimes collapse. The urine is sometimes bloody and quantity is diminished Albuminuria is marked Edema develops in a few days the extent depending on the amount of tubular destruction In chronic chemical poisoning the symptoms develop insidiously with increasing albuminuria variable hematuria and later edema

Prognosis —The prognosis depends on the extent of tubular damage This, in turn varies with the volume of poison absorbed into the system

Treatment —This consists of the elimination of the poison which is usually in the gastro-intestinal tract. The first step is to wash out the stomach A standard stomach tube is passed and the contents are evacuated rapidly If the patient is seen early, that is, shortly after he has taken the poison no cathartic should be given After the stomach has been emptied and thoroughly washed out with soda solution (2 tablespoonfuls of baking soda to 1 qt. of water)

or normal saline solution, 1 qt of milk into which have been broken three raw eggs is placed in the stomach. The patient is then put to bed and kept warm with blankets and hot pads An ampule of coramine should be given intravenously as often as necessary to keep up blood pressure and to ward off shock Caffeine citrate should be given in 7½ gr doses at frequent intervals. The patient should be kept in bed until the blood in the urine has disappeared and danger of shock is past

In chronic poisoning recognition of the etiology and removal of the patient from the environment of the damaging poison is necessary

LIPOID NEPHROSIS —This disease is characterized by the deposit of lipoids in the kidneys, particularly in the proximal convoluted tubules. It may occur alone or with acute glomerulonephritis or amyloid degeneration of the kidneys. It is sometimes associated with tuberculosis or syphilis.

Symptoms and Diagnosis —The onset is insidious and the first symptom generally noticed by the patient is dropsy He may also complain of malaise headache and anorexia. Some patients lose considerable weight, but this is often not evident because of edema There is no hypertension The urine shows enormous quantities of albumin usually no blood cells and a diminution in total output.

Various tests for renal function such as the intravenous phenol sulfonephthalein test, the blood urea or urea concentration tests are negative However the water concentration test shows that kidney function is not normal The blood serum and plasma appear distinctly milky owing to the high concentration of fats and lipoids. Because much of the blood protein is lost in the urine, there is a decrease in the total protein content of the plasma largely at the expense of the albumin fraction with resultant inversion of the albumin globulin ratio Other blood changes occur including an increase in fibrinogen content of the plasma and a decrease in colloid osmotic pressure The velocity of sedimentation of the red blood

cells is increased Lipoid nephrosis is differentiated from chronic diffuse glomerulonephritis by the presence of large amounts of albumin in the urine without blood cells or with few red cells in the urine

Prognosis —The prognosis is poor, although the disease may last for years The termination depends on whether death is due to the lipoid nephrosis itself or whether a chronic glomerulonephritis or amyloid disease is superimposed on the lipoid nephrosis Most commonly, however, death is due to pneumococcic peritonitis, particularly when lipoid nephrosis is found in a child Other intercurrent diseases also are usually fatal

Treatment —Since much of the protein of the blood is lost in the urine, a high protein diet should be given In a 2,500 calorie diet, 240 Gm should be protein, 40 Gm fat and about 300 Gm carbohydrate Epstein recommends a diet of all kinds of lean meats and fish, especially lean veal and ham, and the white of egg, oysters, gelatin, lima beans, lentils, split peas, green peas, mushrooms rice, oatmeal, bananas, skimmed milk, coffee, tea and cocoa The salt intake should be reduced to a total of ½ teaspoonful and the fluid intake to 1,000 to 1,200 cc daily Fluid intake should be carefully balanced with fluid output When diet and limitation of salt and fluid intake will not control the edema, thyroid extract should be administered This is best started in doses of ½ to 1 gr (U S P), three times a day, and rapidly increased so that in a few days 5-10 gr is being taken Large amounts of thyroid will reduce the edema, increase the amount of urine and increase the basal metabolic rate While the patient is taking large amounts of thyroid extract he will perspire readily and profusely and be quite nervous, so that as soon as feasible the amount of thyroid extract should be reduced

Diuretic drugs, such as caffeine citrate or theophylline in 5 gr doses three times a day, should also be given Warm baths also seem to help to reduce the edema It is not necessary to keep the patient in bed after the edema has disappeared Usually when he first gets

up he has moderate edema of the ankles which will also disappear If the patient eats and drinks moderately secures adequate and regular rest and does not overexercise, he may live comfortably for many years. It is said that residence in a dry warm climate is beneficial.

AMYLOID NEPHROSIS.—This is a complication of a long-standing suppurative process most often chronic osteomyelitis Empyema and other suppurative processes as well as such systemic diseases as syphilis and tuberculosis, particularly when combined with tuberculosis of the bone or intestines, may be the cause of amyloid nephrosis. Other etiologic conditions are chronic forms of malaria, dysentery and gonorrhea. Amyloid may also be deposited in the liver spleen, adrenals and intestines and may be deposited in the kidney alone or with lipoid nephrosis.

Amyloidosis causes the kidneys to enlarge to as much as twice normal and to take on a waxy appearance. The glomeruli are filled with amyloid. The tubules show secondary degenerative changes of the character seen in lipoid nephrosis.

Symptoms and Diagnosis—Amyloid nephrosis itself usually causes few symptoms. The only constant finding is albumin in the urine in moderate amounts with a few hyaline and granular casts. The spleen and liver may be palpable, and when amyloid deposits are present in the intestines diarrhea occurs When lipoid nephrosis is superimposed, the quantity of albumin becomes markedly increased and edema develops.

Treatment—Treatment consists of control of the underlying suppurative process or systemic disease In syphilis it is sometimes difficult to determine whether the albumin is due to an amyloid change or to a chemical nephrosis produced by arsenical therapy If two or three months have elapsed since the administration of any drug we believe it is justifiable to resume antisyphilitic therapy Quantitative tests of the urine for albumin by the Esmarch method should be done weekly

Sclerotic Nephritis

Sclerotic nephritis may be subdivided into
1 Arteriosclerotic nephritis
2 Arteriolosclerotic nephritis

The former, which involves only the larger blood vessels, is a part of a generalized arteriosclerosis and produces no characteristic clinical picture and usually only slight impairment of renal function The latter which involves the small arterioles as well as the larger arteries is more serious It may occur (1) without renal insufficiency but present the clinical syndrome of *benign hypertension* or (2) with renal insufficiency with occlusion of a sufficient number of afferent arteries to cause a loss of enough glomeruli to affect kidney function This is the process which takes place in *malignant hypertension*

The etiology of renal arteriolosclerosis is not known The rôle of the common infectious diseases syphilis tuberculosis gout, diabetes alcohol, tobacco tea and coffee is problematical Of greater importance are the inherent qualities of the arteries

Symptoms —The symptoms of renal arteriosclerosis are negligible since there is only a slight diminution in kidney function The symptoms of renal arteriolosclerosis *without* renal insufficiency are clinically those of benign hypertension

The symptoms of renal arteriolosclerosis *with* renal insufficiency (malignant form of renal arteriolosclerosis) first appear clinically as persistent hypertension with normal kidney function About 10 per cent of patients with hypertension develop signs of renal insufficiency and die as a result After two to 20 years there are added to the persistent hypertension all the symptoms of renal insufficiency At this stage, the patient generally complains of severe headache frequently migrainous, and intermittent attacks of vertigo Transitory or permanent attacks of paralysis are not uncommon Aphasia sometimes occurs In some patients sudden increases in intracranial pressure manifest themselves by convulsions These patients are

often unduly irritable and fretful Some have serious attacks of depression and may exhibit other mental disturbances Dyspnea on exertion, paroxysmal attacks of dyspnea at night and hemorrhage from the nose and lungs occur as in benign hypertension. The blood pressure generally ranges between 200 and 300 mm Hg and has therefore definitely passed the fluctuating stage noted early in the disease. The diastolic blood pressure is usually 120-150 mm Hg Marked cardiac hypertrophy is usually greater than in benign hypertension. When renal insufficiency is established the eyegrounds show albuminuric retinitis. This can be recognized by presence of a star shaped figure around the macula, irregular areas of exudate through out the remainder of the retina and old and fresh retinal hemorrhages. The optic disk is blurred and the veins are congested. Patients with albuminuric retinitis usually die in one to two years.

In the early stages when there is no renal insufficiency the daily urine output and specific gravity of the urine are normal and there are no casts or albumin in the urine. As renal failure becomes manifest the amount of urine increases becomes pale and the specific gravity is lowered and often fixed around 1 006 Because of the large amount of dilute urine passed, the patient often complains of nocturia. Albumin is found only in moderate amounts, and the disease may run its course with only a trace of albumin. As absolute renal insufficiency develops the daily urine output is diminished and eventually becomes fixed at a certain output per hour As the disease progresses the phenolsulfonephthalein and water tests and Mosenthal test diet show diminishing renal function for example finally only a trace of or no phenolsulfonephthalein is excreted. Blood studies show an increase of nitrogenous waste products. When the nonprotein nitrogen content reaches 150 mg., symptoms of chronic uremia appear including fatigue loss of weight and appetite, nausea and vomiting restlessness and a tendency to drowsiness

Diagnosis —The differentiation of chronic glomerulonephritis and renal arteriolosclerosis is sometimes impossible. After one has followed a patient for a period of years diagnosis is easier

Treatment —The treatment of renal arteriolosclerosis before the appearance of renal insufficiency is that of benign hypertension After renal insufficiency supervenes, the treatment is that of uremia

Uremia

Uremia may be a manifestation of diffuse glomerulonephritis, nephrosis arteriolosclerotic nephritis or any other cause of urinary retention It can occur with benign prostatic hypertrophy carcinoma of the prostate rupture of the urethra bilateral obstruction of both ureters from stone or stricture, or reflex anuria following the passage of urethral sounds or instruments In some of these conditions surgical intervention must be prompt to save the patient's life In these cases recovery is usually rapid since there has been no permanent damage to the kidney In uremia due to glomerulonephritis nephrosis and arteriolosclerotic nephritis the kidneys are permanently damaged and although death may be postponed, permanent recovery is not possible

The general management of uremia consists of removal of or relief from any obstructive lesion of the urinary tract that may be present, maintenance of body fluids, relief of abdominal distention, excretion of waste products through the bowels until the kidneys are again able to assume this function and control of convulsions when present When a patient is first seen in uremia and there is no obstruction in the urinary tract the order of procedure is as follows

1 Morphine sulfate ¹⁄₄ gr is given hypodermically if the patient is restless, twitching or in a convulsive state

2 Enemas are used to cleanse the lower bowel thoroughly to remove toxic nitrogenous products and to make room for more feces from the upper intestinal tract

3 External heat is applied over the kidneys

4 Indwelling stomach suction tube is used The stomach should be thoroughly evacuated and washed with tap water to remove nitrogenous retention products and the tube then connected to a

Wangensteen, Orr-Curphey (Fig 16) or Davis suction apparatus.

5 Blood is drawn for analysis, typing and count, and the needle left in place for administration of fluids intravenously

6 The needle is connected for continuous intravenous drip preferably of Hartmann's or Ringer's solution or 5 per cent glucose
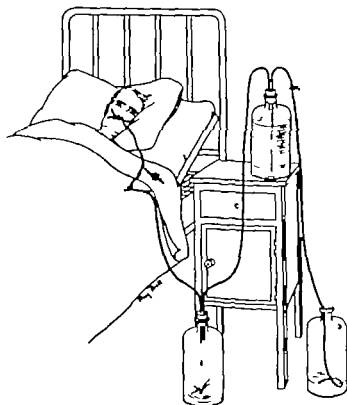

FIG. 16.—Continuous gastric suction with the Orr-Curphey suction apparatus.

in normal saline The rate of drip should be 40 to 50 drops a minute. Usually 3 000 or 4 000 cc. of fluids should be given daily when nothing can be taken by mouth. When there is complete anuria, 5 000-7 000 cc. of fluids may be given to increase hydrostatic pressure to the point where the kidneys must secrete (but this must not be continued too long)

7 Application of heat to the abdomen relieves abdominal distention and distress. Usually an electric hot pad is applied. It should

be closely watched so that the comatose or semicomatose patient is not burned

8 Catheterization is done when necessary or a retention catheter is inserted when this is deemed advisable particularly in the aged prostatic patient

9 Magnesium sulfate is given through the stomach tube one to three times daily in doses of 1 or 2 oz of the saturated solution

10 Blood transfusions of 300 to 400 cc every other day may be necessary particularly if marked or even moderate anemia is present

11 Water by mouth ad libitum should be given when the patient emerges from coma At first it is best that gastric suction be allowed to carry off all the water but after 24 hours the suction tube can be clamped off for 15 to 45 minutes each hour In this way the patient is allowed to absorb some of the water taken in

12 As the coma lessens other fluids are given the administration of intravenous fluids and blood transfusions is discontinued and gastric suction stopped Adequate attention must be paid to the bowels

Many patients recover from active uremic manifestations even when severe and permanent kidney changes are present and may live for several years Death may then occur from another uremic manifestation some intercurrent infection or an entirely unrelated cause

5

Kidney Ptosis

THERE ARE two reasons for writing this chapter (1) the tendency on the part of some clinicians to ignore this disease entity and (2) the great mass of misinformation in the literature regarding the meaning of floating kidney

Any disease which occurs in 20 per cent of women and 1 2 per cent of men is important enough to engage our study Statistics are available on this subject from many sources. In approximately 70 per cent of cases the right kidney is involved, in 10 per cent the left kidney alone and in 20 per cent of women both kidneys are ptotic. Nephroptosis is almost never found in children. It rarely produces symptoms in persons under 20

ETIOLOGY —Rayer wrote a three volume treatise on the kidney in 1837 and reported several cases of dropped kidney the first reported in modern times

Dietl in 1864 published a series of monumental articles on ptosis of the kidney and immortalized himself by having every pain in the kidney called Dietl s crisis. The picture as Dietl saw it is well worth a brief review The European peasant woman in Dietl s time was nothing but another farm animal. She worked in the fields She pulled wagons in the place of dogs, horses or oxen. She did all the work about the house. She bore innumerable children. It was not uncommon for her to give birth to a baby during the night and go to work as usual in the fields at the break of the same day Is it any wonder that Dietl was able to collect hundreds of cases from his

own observation and to describe so graphically the acute obstruction of the ureter'

Experience shows that one fifth of our women, even today have movable kidneys Has the disease now ceased to be important'

Certain congenital anatomic defects are responsible, to a degree for the trouble Ordinarily the renal fossa is deep and has an almost shelflike niche on which the kidney can ride In cases of ptosis this fossa has been shown to be flat and shallow and to lack the niche This is especially true of the right fossa The renal fascia and the various planes of the renal capsule and fascia may be abnormally lax and the renal vessels and fibrous coverings which form the kidney pedicle abnormally long

There are other predisposing causes Nutritional deficiencies with consequent loss of weight and muscle tone are a factor Some writers have stressed the upright position of man as a factor, but this is incorrect for four-legged animals have movable kidneys quite as often as human beings Tight lacing, as was common 50 years ago has been blamed but although this might have aggravated an existing condition it is not properly considered a cause

It has generally been thought that most cases of kidney ptosis are only a part of a general visceroptosis That this is not true is shown by Mathes 90 cases in which 90 per cent were found not to have an accompanying generalized visceroptosis

The Effect of Trauma. —It is rather interesting to reflect that although 80 per cent of women have some degree of abnormal mobility of one or the other kidney 80 per cent of these have no symptoms referable to the defect In men the situation is reversed for whereas only about 2 per cent have movable kidney fully 90 per cent of these have symptoms referable to the disorder It is not easy to account for this situation

In this industrial age when almost every injury both real and imaginary, calls for a law suit or a hearing before a commission it is well for the physician to know what effect trauma may have in causing a kidney to become detached and therefore abnormally

mobile. However trauma as a causative factor in kidney ptosis must be placed in the same category as trauma as a causative factor in hernia. Ptosis of the kidney was there all the time the trauma merely aggravated a pre-existing condition.

PATHOLOGY—The pathology of renal ptosis is relatively simple The renal pedicle is made up of the veins, arteries nerves and lymphatics entering the kidney This is covered by a fibrous network of areolar tissue which binds it together The pedicle is elongated, sometimes so long that it will allow the kidney to migrate into the true pelvis on the opposite side When thus elongated, the ureter is also abnormally long The length of the normal ureter averages 25 cm. while the ureter of a third-degree floating kidney may measure 30-32 cm. This increase in length occurs almost entirely in what would normally be the upper third of the ureter As the ureter comes out from the kidney it passes toward the midline and soon becomes fixed to the posterior peritoneal wall With the mobile kidney the free portion of the ureter accompanies the kidney wherever it goes the part fixed to the posterior peritoneum only occasionally becomes loose enough to follow

This condition is ideal for development of kinks and acute ureteral obstruction. It is this pathologic condition that bears Dietl's name The kidney falls down. The ureter is stretched to its point of attachment to the peritoneum at which point the kink is formed. This kink often acts as an obstruction and the urine is dammed back within the kidney pelvis The stretching of the kidney and its capsule by the hydronephrosis causes the pain of Dietl's crisis.

The relief described by many earlier writers, after a change of position is dramatic. Usually the patient was placed in knee-chest position, the kink in the ureter straightened, the kidney emptied and the pain was relieved. The patient soon found that such change of position would bring quick relief so needed no prompting to make use of this remedy instantly however bizarre and embarrassing the circumstances might be. Dietl's crisis is now considered by some clinicians to have become a rarity It has not disappeared it merely

has been forgotten and it is not correct to say that because we seldom see this syndrome it was never an important symptom

What happens to the kidney itself, secondary to the ptosis may be of considerable importance As long as the hydronephrosis, caused by the sudden and rather complete shutting off of urinary outflow by the kinking of the ureter is intermittent little damage is done

When infection takes place because of stasis of urine or for other reasons the kidney tends to rotate winding the ureter around the kidney and plastering it to the inflammatory zone surrounding the kidney With this condition established the elements for chronic and permanent hydronephrosis are assembled These small degrees of hydronephrosis even though not continuously present become the starting point for recurring and otherwise unexplained attacks of pyelitis and pyelonephritis The end-result of kidney ptosis may be a large permanent hydronephrosis with resulting thinning of the cortex and loss of function even without infection If infection takes place chronic infected hydronephrosis is present and may result in stone formation in addition to destruction of the kidney substance Strangely enough when the kidney is stretched far enough it ceases to cause sensation of pain

SYMPTOMS AND CLINICAL PICTURE —Chronic pyelitis may be the most important finding with the ptosis discovered during the investigation of its cause There may also be gastro intestinal symptoms caused by accompanying visceroptosis

A routine urologic examination may reveal the presence of a dropped kidney If this kidney is tender on palpation and pus is found in the urine some connection between the two should be suspected

Certainly many of the cases of sagging kidneys are discovered in the search for something else or on routine examination The patient may find a tumor' in the abdomen and come to the doctor to ask about it

Sometimes the whole trouble is ushered in by Dietl's crisis We recall seeing a patient who had that exact picture A school teacher

was mounting a street car when seized with an excruciating pain in her right side. She was brought to the hospital in the early morning, suffering from an acute obstruction of the ureter on the right side. The kidney was freely movable and exquisitely tender A no 7 ureteral catheter was placed in the right ureter and on entering the kidney pelvis 4 oz. of clear urine was evacuated under pressure, with immediate cessation of symptoms. Pyelograms were made which showed the ptosis. We were able to follow this patient for many years. She was not operated on. Instead, she was fitted with a supporting belt and put on a high calorie diet. After five years she had gained considerable weight and the kidneys were no longer abnormally mobile.

Another patient whom we have followed for 22 years still has marked ptosis but gets along with the aid of a support. We have urged her to permit nephropexy but she consistently refuses. However we can see no damage to her kidneys from the ptosis even after 22 years

DIAGNOSIS.—When patients do have symptoms, many signs are referable to kidney ptosis. Pain, intermittent attacks of unexplained pyelitis hematuria, pressure of a palpable tumor attacks of colic without stone and marked decrease in the amount of urinary output followed by a sudden increase should be looked into One suspects the condition from the clinical history and examination of the patient s abdomen.

When the condition is suspected, a urologic examination must be made. This should include intravenous urography with x ray plates made with the patient standing This is particularly valuable in view of the fact that an ovarian tumor on a long pedicle and sometimes a tumor of the cecum will simulate a movable kidney

TREATMENT —Surgical —No group of surgeons agrees on the indications for operation One suspects the surgeons reporting hundreds of cases with nephropexy either of being dominated by a spirit of trade or of being unduly influenced by the patient s desire for an operation. On the other hand, surgeons who never advise operation

may not have sufficient experience or grasp of the subject to feel sure of being able to select the cases properly

There is a small but easily demonstrable group of patients who definitely should have nephropexy The indications for operation are neither numerous nor complicated (1) pain due to the hydro nephrosis, (2) hydronephrosis due to obstruction of the ureter, (3) attacks of hematuria, (4) recurring attacks of pyelitis and roentgen visualization of the ptosis No operation in all of surgery requires more skill and judgment The inexperienced surgeon should not attempt a nephropexy If he attempts to read the surgical descrip tions of operations he will be in a maze

Scores of operations are described Many are palpably no good In our experience, the only principle that need be adhered to is that of removing a portion of the capsule on the posterior surface of the kidney then scarifying the quadratus lumborum at about the point where the psoas m nor almost fuses with it The denuded kidney is then placed on the scarified muscle and the loosened folds of the capsule are stitched to the muscle all around When the kidney adheres as it will shortly it is there for the duration of life We have seen autopsy specimens of this operation done 20 years before, and the pathologist had to cut the kidneys from their bed, so firmly were they adhered

Medical —The foregoing discussion may be all very well for the specialist or surgeon but the practitioner needs to know something more concerning the management of these cases Medical treatment should be tried in cases of nephroptosis without hydronephrosis and, if it fails surgical treatment may then be indicated Medical treatment consists of three simple but important procedures

1 If the patient is a thin woman with a flabby abdomen, a high calorie diet with the idea of adding considerable fat, should be instituted A well balanced diet should be carefully worked out for the patient by her doctor This diet may vary from not less than 3,500 to as much as 5,000 calories per day Cod liver oil. lextron,

liver and iron should be given when hemoglobin content is below 80 per cent.

2 Rest in bed may be indicated for patients who show exhaustion from various causes. A two week stay in bed with the foot of the bed elevated is sometimes highly beneficial.

3 The question of mechanical supports resolves itself into what sort of belt or appliance best fits the individual patient. The average corsetier or brace maker really knows nothing of the underlying medical problem and must be minutely instructed as to what is needed. No woman wishes to deform herself with a support that makes her look "lumpy" The art of placing the support pad inside the girdle belt or corset is important in obtaining a final result—that of supporting the ptotic kidney The pad should measure about 3 X 6 in. and be very thin on one edge and about 1 in. or more thick at the opposite edge The thick edge of this pad as well as its longest edge is placed downward and in such a position that its lower or thickest edge is about 1 in. below the umbilicus on the side of the dropped kidney The pad is stitched to the inside of the corset or belt. This the patient puts on while lying on her back. The patient is instructed first to push the kidney up into position then adjust the pad and next lace the supporting garment snugly shut. Many doctors complain that these devices do not support. However when the patient is properly instructed in the art of placing the support, a high percentage of relief is obtained.

Genito-Urinary Tuberculosis

CAPTAIN or the men of death was the term Sir William Osler borrowed from John Bunyan to characterize pulmonary tuberculosis Renal tuberculosis is next to pulmonary tuberculosis in frequency

In the male genital and urinary tracts have much in common because all the ducts sinuses cavities and glands communicate For this reason in the male we must consider renal tuberculosis and tuberculosis of the genital apparatus as variations of the same disease

The patient with pulmonary tuberculosis is well cared for in the various scientifically manned sanatoriums established for the purpose in every part of the world Such a patient is treated as a person with an infectious disease should be treated that is by consideration of diet medication physical therapy and proper attention to the various complications which may arise On the other hand few of these institutions are equipped to care for the victim of renal tuberculosis Perhaps unfortunately the patient with renal tuberculosis is generally ambulatory Because of this and because he seldom has even a slight degree of fever he mingles with society without hindrance

We know scores of instances in which these patients are a definite menace in the spread of tuberculosis The middle-aged or past middle-aged person with chronic bilateral renal tuberculosis is a great disseminator of the disease We know of dozens of patients whose urine contains myriads of tubercle bacilli These persons void in public toilets soil their clothing which is sent to public laundries, do not as a rule wash their hands after handling their organs and

so are likely to spread contamination on door handles and in public conveyances. These facts are well known among genito-urinary surgeons, yet outside of that fraternity we have never heard a voice raised against this menace or any suggestion for its amelioration.

No matter where the statistics are collected or who collects them there is agreement on one point. That is, that the ages between 20 and 40 are the most important, because 80 per cent of the cases of renal and genital tuberculosis occur in persons between these age limits. As for a predilection for sex there is none male and female are alike attacked.

The broader implications of these statements require further examination. These important years in the life of a man or woman, i.e., 20-40 are the years in which the family should be reared the foundations of financial security laid and the greatest activity take place. The situation for the unfortunate tuberculosis victim is indeed grave. According to the best authorities in approximately 15 per cent the infection is bilateral from the start that is in about one of every seven cases both kidneys are involved when diagnosis is made.

The 85 per cent of patients with unilateral involvement at the beginning constitute the group with surgical tuberculosis—surgical because by removing or amputating the diseased kidney the progress of the disease can be stopped and a cure established. It is not quite as simple as that, but still cures are effected by surgery

The 15 per cent who have the disease in both kidneys present a serious problem. They are condemned to a life of invalidism and properly should be institutionalized. Someone has said that they never die and they never get well. For many years it was believed that spontaneous healing never took place. However we have during the past several years seen many undoubted instances of healing in cases of trusted associates and cases of our own. Unfortunately spontaneous regression and cure are not the rule

CLINICAL PICTURE—The clinical picture of renal tuberculosis is not as clearcut as that of many lesser diseases. The picture is in

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in with food, it may reach the mesenteric lymph nodes. Strange as it may seem the tonsil is often a temporary stopping place for the tubercle bacillus, which is brought there by the blood stream or via the mediastinal lymph nodes. Once in the tonsil the disease spreads to the cervical lymph nodes to cause scrofula. The patient's resistance at this early period may be good and the disease arrested and healed, leaving no evidence. The skin is sometimes mentioned as a point of entrance and so it may be but this is only of academic interest because of its rarity

When a tubercle bacillus or a clump of tubercle bacilli arrives at a given point in the body say in the lungs, it stops in a tiny capillary and an inflammatory process is set up If this rather complicated pathologic picture continues to progress the patient has active tuberculosis, or after the original inflammatory reaction takes place healing may follow The healing lesion is essentially a series of enmeshing fibroblasts which limits the activity of the tubercle In some organs, calcium is attracted by this process and is thought to be a defensive mechanism In other organs, such as the kidney calcification is not the rule. We have however seen calcification in kidneys seriously involved by tuberculosis but generally there is abundant secondary infection which may well be as responsible for the calcium deposits as the tuberculosis.

Tuberculosis in a kidney does not differ from the lesion elsewhere in the body We have come to believe that there are strains of tubercle bacilli with a special adaptation to and fondness for kidney tissue, as has been suggested by other observers (The tubercle is the unit of destruction here as elsewhere The tubercle, once started, spreads by extension, and the necrotic process leaves the field wide open for secondary invaders that hasten the destructive process)

One would assume that with a tuberculous lesion in the kidney tubercle bacilli would always be excreted in the urine Theoretically that is true but actually there may be long periods when no tubercle bacilli enter the urinary stream During periods when showers of bacteria are liberated, the diagnosis of tuberculosis of the kidney

volved and subdued Tuberculosis, like syphilis, is the great imitator of many diseases The complaints which bring the patient to the doctor are nearly always centered around disturbances of the urinary tract.

There are two main types of the disease In the mild, insidious type the predominant features are malaise slight loss of weight, slight impairment of appetite fatigue nervousness, restlessness and apprehension and inability to concentrate on a task When these complaints are coupled with persistent pyelitis or pus in the urine definite investigation for renal tuberculosis should be undertaken Such a patient may have no complaints referable to the urinary tract In the other type constituting three fourths of the cases there are urinary frequency and pain or burning on urination A teasing constant desire to urinate brings the patient to the doctor There is usually a history of many months of urinary distress and all the aforementioned associated symptoms

Sometimes the patient comes to the doctor because of gross hematuria Although hematuria is almost always stressed as a symptom in the textbooks it is not as common as it is supposed to be

Certain patients have no symptoms except slight persistent pyuria They are usually tired and very relaxed and are apt to be classed as lazy The doctor may discover nothing more than pus in the urine If he is astute he will link this to other vague symptoms and finally establish the diagnosis of tuberculosis of the kidney

If in unilateral tuberculosis diagnosis is not made the disease will appear in the opposite kidney in two to five years When the disease becomes bilateral good judgment on the part of the surgeon is necessary to decide on operation and which kidney shall be removed

PATHOLOGY —Urinary and genital tuberculosis are not truly primary but are extensions from some other focus The tubercle bacillus is either ingested with food or breathed into the lungs Where the organisms go after they enter the body determines the type of lesion to be encountered If the nidus is in the lung the victim may develop pulmonary tuberculosis If the organism is taken

in with food, it may reach the mesenteric lymph nodes. Strange as it may seem, the tonsil is often a temporary stopping place for the tubercle bacillus, which is brought there by the blood stream or via the mediastinal lymph nodes. Once in the tonsil the disease spreads to the cervical lymph nodes to cause scrofula. The patient's resistance at this early period may be good and the disease arrested and healed, leaving no evidence. The skin is sometimes mentioned as a point of entrance, and so it may be, but this is only of academic interest because of its rarity.

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can be made by finding acid-fast bacilli in the urine Although at one time it was believed viable tubercle bacilli could pass the normal glomerular tuft, all investigators now agree this does not occur

Two types of tuberculosis attack the kidney (1) the acute miliary type which is seldom of surgical interest and is generally part of a massive and terminal infection, (2) the chronic type, of interest only to the surgeon The miliary type is common and becomes a problem in management for the practitioner

The older surgeons were totally unaware and some general surgeons who do kidney surgery are still unaware of the diagnostic ability of the urologist No urologic surgeon would think of performing an exploratory operation on a kidney to prove that tuberculosis was present A small lesion at the base of a pyramid presents no surface evidence of its presence The classification of the tuberculous kidney has been needlessly complicated The lesion varies with the progress of the disease The first small lesion, as we have pointed out is the tubercle This spreads to form a larger lesion Caseation and necrosis are the rule The confusion arises from the fact that the pathologist does not always recognize the progressively destructive nature of the lesion

The question of whether renal and genital infections are of the human or the bovine type is, we believe, more than academic Koch, who discovered the tubercle bacillus, stated that the bovine type could not infect human beings nor could the human type infect animals, and lived to see himself proved wrong However, the avian tuberculosis is pathogenic for man but not for guinea-pigs, a point which is important lest too much confidence be placed in use of guinea-pigs to find tubercle bacilli

The question of spontaneous healing of renal lesions is pertinent There is no doubt that renal tuberculosis heals spontaneously, but this is rare and much care must be exercised in determining cure The mere fact that a kidney ceases to put out pus-laden urine may not mean that cure has been brought about but that autonephrectomy has been produced This phenomenon is present when the

blood vessels to and from the kidney thrombose completely and the kidney becomes a dead organ. This is a long way from a cure.

DIAGNOSIS.—A carefully written and studied history is of prime importance. The commonest presenting symptom is frequent and painful urination. The term dysuria includes this and strangury and tenesmus. When the patient complains of such urinary disturbances it is well to inquire the time elapsed since the onset and whether onset was slow and insidious. Generally the onset was at least six months previous to the examination at first there was a frequency of once or twice at night, and daytime frequency was not annoying enough to be of note Gradually the nocturia became more pronounced until the patient complains that every hour during the night he must arise and, with increasing discomfort, try to empty the bladder Then daytime frequency increases. About 80 per cent of patients present the foregoing picture with urinary distress as the main feature. Complaints in the other 20 per cent vary greatly and often present problems in diagnosis.

Most textbooks emphasize hematuria as a cardinal symptom, some going so far as to say that approximately 20 per cent of the gross renal hematuria is caused by renal tuberculosis. Our experience of over 26 years indicates that hematuria in renal tuberculosis is rare and not pathognomonic. Nephritis is the leading cause of hematuria.

Renal tuberculosis cannot be diagnosed from the history alone especially in women, in whom many other causes account for bladder disturbances. After a careful history has been taken, a careful routine examination should be made examining the patient in the nude from head to foot, missing nothing After the observations have been recorded, laboratory and roentgen examinations are made Roentgen study of the lungs is important, with stereoscopic plates if possible, for this may yield evidence of an original tuberculous focus.

Blood studies should include the usual red cell counts, hemoglobin determination and white cell with differential counts. Chemi

cal analysis and sedimentation tests are not important at this stage and can be postponed until later Urine studies should next be made The routine chemical and microscopic examinations of the urine should yield some evidence The specific gravity in a subacute or chronic case of renal tuberculosis is often low and the urine is pale and turbid If pus cells are found, their number per cubic millimeter should be noted Failure to find pus cells does not exclude tuberculosis of the kidney, for the old dictum "no pus in the urine, no tubercle bacilli" is not true Although rare, absence of pus in the urine occurs often enough to be a stumbling block even to the most astute physician

One may have to make repeated examinations of the urine before finding acid-fast bacilli, because the nature of the lesion in the kidney is such that bacteria are only occasionally spilled over into the urine It follows, then that one negative examination of the urine for tuberculosis means nothing, whereas one positive finding cannot be disregarded The method outlined on page 24 is the most reliable for finding the acid-fast bacilli

Once the bladder urine is shown to harbor tubercle bacilli, the hunt is on to locate the exact site in the genito-urinary tract in the male and in the urinary tract in the female

The next step is the technical procedure of cystoscopy and ureteral catheterization Occasionally this may be preceded by intravenous urography These studies may be of considerable value, but are not to be relied on for final diagnosis The cystoscopic examination may reveal classic tuberculous lesions in the bladder It is a curious fact that sometimes lesions are seen around the good or normal-appearing ureteral orifice This is because the streams of urine impinge on each other if the ureteral orifices are so situated on the trigon that they point toward each other The discharge from the infected kidney and ureter impinges on the uninfected side, showing misleading implantation

There are splinting and straightening of the bladder wall on the affected side The golf-hole ureter, described in all texts, is highly

significant. The infected ureter because it is inflamed and thickened in its transverse diameter shortens, and the ureteral orifice is pulled out of the bladder producing the appearance of a golf hole.

Catheters are next passed to the kidney. The careful urologist connects the ureteral catheter to the irrigator with a hypodermic needle so that there will be a continuous flow of sterile water from the end or tip of the catheter while passing it into and up the ureter This effectively prevents bacteria from being carried on the catheter from the bladder to the uninfected kidney There may be strictures in the ureters so that no catheter however small, can be passed. After the catheters are in place in each ureter the kidney pelvis is tapped and urine collected from each kidney The bottles, labeled "right and left," should be of sufficient volume to allow collection of enough urine for a complete urinalysis Sometimes it will be noted that the diseased kidney puts out twice the volume of urine that the normal kidney does This is because the diseased kidney increases its volume output in an attempt to keep up its normal excretion of solids.

Intravenous dye tests, such as the indigo carmine and phenolsul fonephthalein tests, are helpful Five cubic centimeters of indigo carmine is injected in the vein of the arm and the time noted. The time of appearance of the dye in each ureteral catheter is noted and the concentration of the dye observed. The phenolsulfonephthalein test takes longer and although it seems more accurate yields no more information than the indigo carmine as to kidney function.

The next step is pyelography The roentgenologist makes a preliminary or scout plate of the K.U.B. (kidneys-ureters-bladder) It is important to make intravenous urograms in cases of suspected renal tuberculosis for many times retrograde pyelograms will not be necessary after these plates are read. In fact, many urologists object to the passing of catheters to the kidney in these patients every effort, therefore should be made to obtain good intravenous urograms. It should be remembered that the tuberculous kidney is irritable and tends to expel rapidly the opaque medium (as it
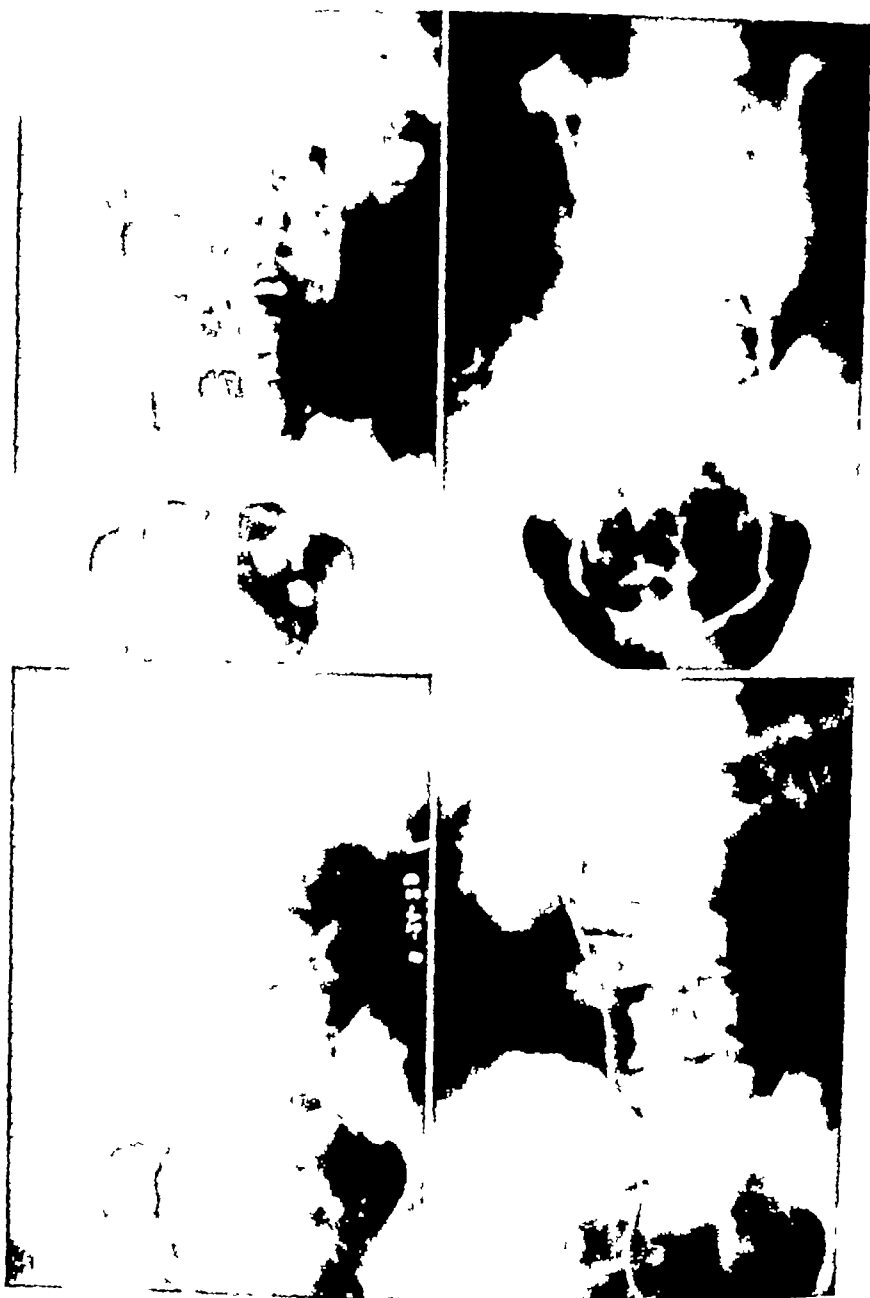
FIG 17—Renal tuberculosis *Upper left* in left kidney in man, 31 Rounded calcification near bladder was diagnosed bladder stone, nephro ureterectomy was necessary *Upper right* bilateral, in man, 32 *Lower left* long standing bilateral, in man, 58 *Lower right* unusual type with hydronephrosis, nephrectomy wound did not heal

comes from the blood stream) down the ureter and into the bladder The patient should be placed in marked Trendelenburg position to use the aid of gravity in the retention of the opaque medium in the kidneys long enough to obtain good plates. If retrograde pyelograms are necessary before injecting skiodan diodrast or other contrast medium, the capacity of the kidney pelvis on either side should be measured. The normal kidney pelvis will hold about a teaspoonful or 5 cc., and 6 cc. of medium will fill the kidney pelvis and ureter If a measurable hydronephrosis is present, enough opaque medium should be used to fill the kidney pelvis The medium should be warmed to body temperature and injected slowly and carefully A bubble drawn into the syringe before starting and used for a pressure gage is of value watch the bubble and do not allow it to become compressed. This is accomplished by injecting slowly and using only gentle pressure

The x ray plates should be studied by an expert for the fine points of interpretation cannot be learned by any short cuts Figures 17 and 18 show how great the variations may be.

The diagnosis then is made from

1. The history
2. The physical examination
3. The examination of the urine, particularly the finding of tubercle bacilli.
4. The urologic examination, or examination of the urinary tract.
5. The x-ray plates of the K.U.B and the pyelograms

TREATMENT—The treatment of renal tuberculosis is medical or surgical, or both. Decision as to the best course of treatment in each case requires extensive knowledge of renal tuberculosis and excellent judgment.

Patients with renal tuberculosis who have active pulmonary tuberculosis should be treated until the lung lesions heal and the patient no longer has the daily slight elevation of temperature. Medical treatment of unilateral subacute or chronic renal tuberculosis may

be undertaken as a preliminary or preparatory régime to surgery Medical treatment in certain cases should follow nephrectomy

Treatment of the Tuberculous Bladder —Often successful control of the irritable bladder taxes the resources and ingenuity of the attending physician Many years ago Thorkild Rovsing, the Copenhagen surgeon (1862-1927) suggested the use of 1 or 2 per cent

FIG 18 —Renal tuberculosis *Left,* involvement of right kidney in boy, 12 Badly done nephrectomy resulted in long-standing sinuses in wound *Right,* bilateral involvement in girl, 13 Seven years later, left nephrectomy was done, and right kidney recovered She married and had a normal pregnancy—a case of apparent cure

carbolic acid solution for instillation into the tuberculous bladder This is still good treatment We have varied this by using an instillation of 15 cc of a 1 1,000 solution of nupercaine before instillation of the phenol (10 cc of a 1 per cent solution), with happy results Another method we like makes use of the following prescription

R	1 5,000 metaphen in oil A	100 cc
	Anesthesin	1 Gm
	Phenol	1 Gm

Mix the ingredients until all are dissolved (they are oil soluble) and instill 10 cc. into the bladder once a day

In most instances the tubercles disappear from the bladder and the capacity of the bladder increases.

Systemic and General Treatment —Sulfacetimide one 7½ gr tablet three times a day many times effectively clears the secondary invaders and causes general sterilization of the body fluids. Penicillin in appropriate doses often accomplishes wonders. We are all awaiting the possibilities that are, perhaps, locked up in streptomycin before long this drug will also be available for the treatment of renal tuberculosis. In certain inoperable cases in which there is bilateral and fairly chronic renal tuberculosis from the start, we have used the following medical program with success

1 The patient is kept in bed until he no longer has fever and the x-ray plates show no signs of active pulmonary tuberculosis. This may be two months or two years.

2 The patient should have plenty of fresh air and adequate exposure to the sun or proper rays from a suitable actinic lamp Care must be exercised to prevent erythema of the skin from even slight overexposure. For blonds and red haired, thin-skinned persons, 10 minutes back and front daily in the noon sun is enough. This time can be increased later but under no circumstances should a sunburn, however slight, be permitted, for this would tremendously increase the irritation of the kidneys and superimpose nephritis on the tuberculous infection.

3 Fluid intake should be adequate 2 700-3,300 cc. per 24 hours is about optimal.

4. The diet should be full and well-balanced, with six feedings a day if necessary unless this increases weight too much in those with a natural tendency toward adiposity Fruits and fruit juices should be given in abundance.

5 Cod liver oil should be given daily and the vitamin B complex should be prescribed. The bowels should be kept open, using mucilose or other bulk producers. Cathartics should be avoided.

Sulfacetimide, 1 or 2 tablets three times a day after meals in four day courses two or three times each month, has a definite inhibitory effect on the growth and development of the tubercle bacillus and keeps down secondary invaders Tuberculin is useless, if not positively dangerous In some cases, calcium, in the form of calcium chloride, calcium gluconate or other colloidal forms, seems to be beneficial These are put up in tablet form, and 15 to 30 gr daily is an average dose Many other drugs and chemicals have been suggested and found wanting

Surgical Treatment —When the diagnosis of unilateral renal tuberculosis has been established and presence of a sound kidney on the opposite side is assured, nephrectomy by the extraperitoneal lumbar approach is the procedure of choice The patient s condition will determine whether preliminary medical treatment is essential to a successful operation

Some surgeons advise against removal of a completely dead tuberculous kidney By completely dead, we mean one whose pedicle has undergone such degenerative and thrombotic changes as to render it functionless (autonephrectomy) We believe nephrectomy advisable and on several occasions have removed such a kidney with good results To leave such a large focus of infection when it can easily be "amputated" is not sound surgery

Sometimes it is good surgery and good treatment to remove the more advanced of a pair of tuberculous kidneys We realize that this is dangerous doctrine, but on several occasions we have seen the lesion in the remaining kidney heal Furthermore, we believe that the remaining kidney would not have healed had its infected fellow been allowed to remain undisturbed

No surgical procedure is 100 per cent successful in renal tuberculosis Persistent sinuses form, to plague the patient and his physician Wounds break down and occasionally never heal, no matter how many times or how well they are closed Since using sulfathiazole powder in the wound and closure without drainage, and using ascorbic acid by mouth, our wound failures have been practically nil

When the ureter is thickened and diseased in its entirety it is well to do a ureterectomy also

In a good many cases nephrectomy fails to stop the progress of the disease according to some authorities, as many as 40 per cent are not benefited greatly by nephrectomy This has caused internists and some surgeons to question the wisdom of nephrectomy even for unilateral renal tuberculosis The immediate mortality for nephrectomy is low being 3-5 per cent in a large series of cases. In early cases, nephrectomy gives cures in as many as 90 per cent. In the later or more advanced cases, cures average 50-60 per cent. When this is weighed against the absolute hopelessness without nephrectomy, there is no reason for temporizing

PROGNOSIS.—The outlook for the patient with bilateral renal tuberculosis is not particularly poor as to life. He must, however look forward to a life of invalidism. The greatest discomfort comes from the contracted and irritable bladder necessitating frequent painful efforts at urination.

If as in many of our cases, the secondary infection can be limited, the patient may lead a fairly normal existence and be able to carry on some form of work We have a considerable number of such patients under observation who get along fairly well. Those who acquire the disease when they are under 20 do not have as good a chance as those who acquire it between 30 and 40

Sixty five to 70 per cent of nephrectomized patients get well and need no further attention. The other 30 to 35 per cent need constant attention. Some of these also carry active lung lesions. The patient about to have a nephrectomy asks "Will I be able to live with only one kidney?" The answer is nearly always "Yes. However the nephrectomized patient does not actually live as long as the person with two good kidneys.

Genital Tuberculosis

The association of genital and renal tuberculosis is too common to be dismissed lightly The genital tuberculosis we are most inter

ested in is that of the male organs—the prostate, seminal vesicles and epididymis, of which the most important is the epididymis because of its relatively more external and accessible position If the epididymis becomes infected first, the vas, seminal vesicles and prostate on the same side will probably be invaded by extension While it is impossible to separate the genital tuberculous process anatomically, it is simplest to consider the disease process in anatomic order

Prostate —Primary invasion of the prostate by tubercle bacilli is rare As a part of the process known as genital tuberculosis its involvement is not uncommon It is difficult, if not impossible, to distinguish simple or nonspecific prostatitis with a tendency to form multiple small abscesses from a tuberculous lesion in the prostate The clue is found in the tuberculous epididymitis that nearly always accompanies the prostatic lesion The disease in the prostate is described as starting in the posterior lobe close to the ejaculatory ducts If it starts to one side, the seminal vesicle on that side may also be invaded The prostate is supplied with acini and the disease spreads from lobe to lobe via these acini There are also lymphatics by which the disease spreads from one part to the other

Seminal Vesicles —If the ducts into the posterior urethra and the ampulla of the vas become occluded in the process of a tuberculous invasion, a cold abscess may develop in the seminal vesicle and swell the organ to enormous size before it ruptures

The process is the same as in tuberculosis elsewhere in the body It usually attacks the mucosa first, then enters the walls of the vesicles The seminal vesicle, being a coil of tubing which, when straightened, is about 5 in long, normally holds 5 or 6 cc of fluid When infected and dilated by a cold abscess, it may be 6-10 in long and contain as much as 25 or 30 cc of pus The position of the vesicles on either side of the prostate and bladder neck and between the bladder and the rectum makes them important as a threat to both bladder and rectum

Epididymis —This coiled organ is about 2 in long and grossly

appears as a crescent surrounding a part of the testicle. As the testicles hang in the scrotum the epididymis is on the posterior aspect. The upper end is called the globus major and the lower end the globus minor At the lower end, or globus minor the vas deferens begins. If the epididymis were uncoiled, it would measure 19-21 ft. It has been argued that the epididymis can be the seat of a primary focus of tuberculosis but this has only theoretical interest.

DIAGNOSIS.—As in renal tuberculosis, the history is often obscure. The diagnosis is arrived at by following a clue such as pus-laden urine without apparent cause or a hard lump in the testicle," similarly without reason. Examination may lead to a presumptive diagnosis of tuberculosis of the genital tract. A thickened vas is further evidence Examination of the prostate and seminal vesicles by rectal palpation may reveal further trouble

When the lump is found in the epididymis and evidence of infection is discovered in the prostate and seminal vesicles, the diagnosis becomes clear The hard "lump" in the epididymis is usually discovered on routine examination by the doctor or accidentally by the patient. The question then arises, what is this small hard mass? The hardness of the epididymis caused by tuberculosis is not in the testicle but in the epididymis. It may be a small hard nodule in distinguishable from an acute epididymitis which has subsided it may be so large as to obscure the testicle Some tuberculous epididymes are so characteristic as to be unmistakable. (For a fuller discussion of the differential diagnosis see Chapter 16) A small tumor of the teratoma variety is sometimes felt in the lower pole of the testicle and cannot be distinguished by palpation from a lump in the epididymis. In our experience, medical students are the only ones who discover very early teratomas in their testicles

The ordinary epididymitis of bacterial origin is marked by great swelling pain, heat and fever and should not be confused with tuberculosis. When sinuses are present leading from the tuberculous epididymus to the skin of the scrotum, the diagnosis is unmistakable In some instances and in advanced cases, examination of the urine

will reveal tubercle bacilli Examination of the seminal fluid will sometimes reveal the bacilli Urine that is sterile on culture or smear but still shows pus is highly suggestive of tuberculosis

TREATMENT —Surgical removal of the massively infected epididymes is the procedure of choice in most instances Surgery on the tuberculous prostate or seminal vesicles is not very smart and the surgeon can easily exchange the devil for a witch If one epididymis is involved, surgical removal can prevent the spread to the opposite side

Medical treatment as outlined earlier for renal tuberculosis applies definitely here and should be a part of the management with surgery

PROGNOSIS —Genital tuberculosis has considerable morbidity but low mortality The outlook is much better when not associated with renal tuberculosis When associated with renal tuberculosis, the prospect is bad, for there is a high delayed mortality In general, the older the patient, the better the prognosis Patients past 50 seem to have considerable immunity Those under 30 seem to succumb most rapidly All the patients we have seen with tuberculomas at or near the bladder neck have had a rapidly fatal course

The patient with genital tuberculosis may live many years He is almost always sterile but not impotent He undoubtedly has a considerable capacity for spreading the disease He may not be sterile if only one epididymis is infected, but there is no guarantee that both sides will not ultimately become invaded If the infected tuberculous epididymis is not removed surgically it may in rare instances recede, but usually the disease extends into the testicle and destroys it With sinus formation, we have seen the disease spread to the skin of the scrotum, perineum and thighs

Hydronephrosis

HYDRONEPHROSIS LITERALLY means water kidney, the water in this case being the urine The average normal kidney pelvis will hold about 6 cc. of fluid or a little more than 1 teaspoonful. There is considerable normal variation—between 3 and 8 cc. This does not mean that the normal kidney actually retains that amount of urine in its pelvis, but that that amount of fluid when injected into the pelvis, will just fill it to capacity

Another name for hydronephrosis is pyelectasis meaning dilatation of the renal pelvis. Hydronephrosis differs somewhat from pyonephrosis, although they may be much alike Hydronephrosis is not the product of infection, while pyonephrosis is the result of infection within the kidney and does its work by destruction of renal tissue. Hydronephrosis is caused by atrophic changes in the renal structure from pressure of urine in the kidney pelvis and of atrophic tissue of the kidney itself interfering with its blood and lymph supply

There are many degrees of hydronephrosis from dilatation of a single calix to sacculation of a kidney that will hold 36 L. of fluid. Hydronephrosis is often mistaken for tumor of the kidney especially in children and is sometimes diagnosed ovarian cyst when the kidney is freely movable

Acute hydronephrosis sometimes occurs when a stone becomes impacted in the ureter or when acute ureteral obstruction takes place

The three main causes of hydronephrosis may be grouped as mechanical neurogenic and endocrine.

MECHANICAL CAUSES —This group constitutes the largest and most important list of the causes of hydronephrosis

1 *Impacted Stone* —A stone may be impacted at any point along the urinary channel Rarely, a stone remains impacted in the male urethra long enough to produce sufficient back-pressure to cause the kidney to dilate and form a hydronephrosis A stone in the bladder, whether large or small, may cause dilatation of the kidney pelvis

When a stone forms in the kidney pelvis, it is usually first located at the tip of a calix When it reaches a certain size, it may loosen and start down the ureter If the stone is too large to pass down readily, it stops in the funnel-shaped portion of the ureter or kidney pelvis and may effectively plug the ureter Immediately, the kidney pelvis begins to fill, because the filtering units continue to secrete urine Pressure increases in the kidney and the kidney stretches This stretching at first causes pain, but if long continued, the pressure dulls the nerve endings and pain ceases If a groove is formed in the margin or periphery of the obstructing stone, the urine can pass and the hydronephrosis is relieved The condition may recur if the stone does not pass, and intermittent hydronephrosis develops

The stone may slide a little lower down the ureter and stop several times during descent of this 12 in tube Each time the stone stops, intermittent hydronephrosis may be repeated In persons under 30, the kidney may suffer no damage from this inordinate stretching and will snap back to its original size In persons over 30, considerable permanent damage to both kidney pelvis and kidney may result, so it is unwise to allow intermittent hydronephrosis to become chronic The same mechanical process can be repeated anywhere along the urinary tract from a minor calix to the tip of the external urinary meatus Should infection be added to this, the picture quickly changes

2 *Tumors* —Tumors outside the urinary tract or formed of tissue within the urinary system may obstruct the urinary passages Only occasionally do tumors of the kidney have hydronephrosis as a main

feature, although it may develop as part of the picture. We have seen a number of cases in which hydronephrosis developed because a papilloma of the kidney pelvis obstructed the outflow of urine at the ureteropelvic junction.

FIG. 19—Large calcified fibroid tumor in pelvis causing obstruction of right ureter

In children, Wilms's tumor may have hydronephrosis as its predominating feature, and care must be taken not to consider the hydronephrosis and overlook the tumor

Hydronephrosis is often part of the terminal picture of carcinoma of the cervix. The position of the ureters in the female—close to the cervix on either side—favors their inclusion in the growth. When the cancer invades the ureteral wall and infiltrates it to occlude the

lumen, permanent hydronephrosis develops It becomes necessary in some either to reimplant the ureter into the bladder or to bring the ureter to the surface in the form of a ureterostomy

3. *Congenital Anomalies* —Congenital narrowing of the external urinary meatus in the male may cause bilateral hydronephrosis

FIG 20 —Hydronephrosis and hydro-ureter with cervical carcinoma which has infiltrated and surrounded the ureter, markedly obstructing it

Strictures of the male or female urethra, whether congenital or acquired, may result in hydronephrosis Congenital strictures of the male urethra are quite rare and are usually discovered during the first few weeks of life The various congenital narrowings of the bladder neck, such as fibrous contracture of the prostatic urethra and internal urinary orifice, congenital valves and cysts of the prostate or verumontanum may produce hydronephrosis The various

forms of ectopic ureter are frequently responsible ureteral orifices have been found opening into the vagina, cervix, uterus, seminal vesicle, prostatic urethra urethra in the female outside on the vulva beside the urethra and elsewhere. Nearly all these bizarre implanta

Fig. 21—Ureterocele of right ureter in woman 30 obstructing flow of urine sufficiently to cause pain in the right kidney Removal of ureterocele with high frequency loop cured the condition.

tions produce hydronephrosis. Usually they are in the form of an extra ureter that is, a third or even a fourth ureter and are often associated with another anomaly such as a double kidney Such a condition often causes hydronephrosis in one half of a double kidney (Such pathologic processes are discussed in Chapter 10)

Congenital strictures of the ureters may involve either or both

FIG 22 —Hydronephrosis due to aberrant renal artery to lower pole of the
kidney The ureter is not affected in any case In most cases of hydronephrosis,
aberrant artery has a role Aberrant arteries to the upper pole never cause
obstruction

ureters. This type of stricture appears at the ureterovesical junction where the ureters enter obliquely into the bladder

A rather rare anomaly is known as ureterocele (Fig. 21) This

FIG. 23 —Hydronephrosis of 1,000 cc. capacity due to aberrant renal artery to lower pole. Nephrectomy was necessary for relief

may also be acquired. The condition is a cystic dilatation of the lower end of the ureter and regularly produces hydronephrosis. It may be unilateral or bilateral.

The various kidney anomalies, such as pelvic ectopic kidney horseshoe kidney unilateral fused kidney and double kidney all tend to cause faulty flow of urine and thus predispose to hydro-

nephrosis Exstrophy of the bladder, said to occur about once in fifty thousand births, predisposes to hydronephrosis

4 *Strictures* —Urethral strictures of inflammatory origin may cause hydronephrosis, particularly if neglected or badly treated A stricture can occur in any part of the urinary system from the neck of a calix in the kidney to the external urinary meatus
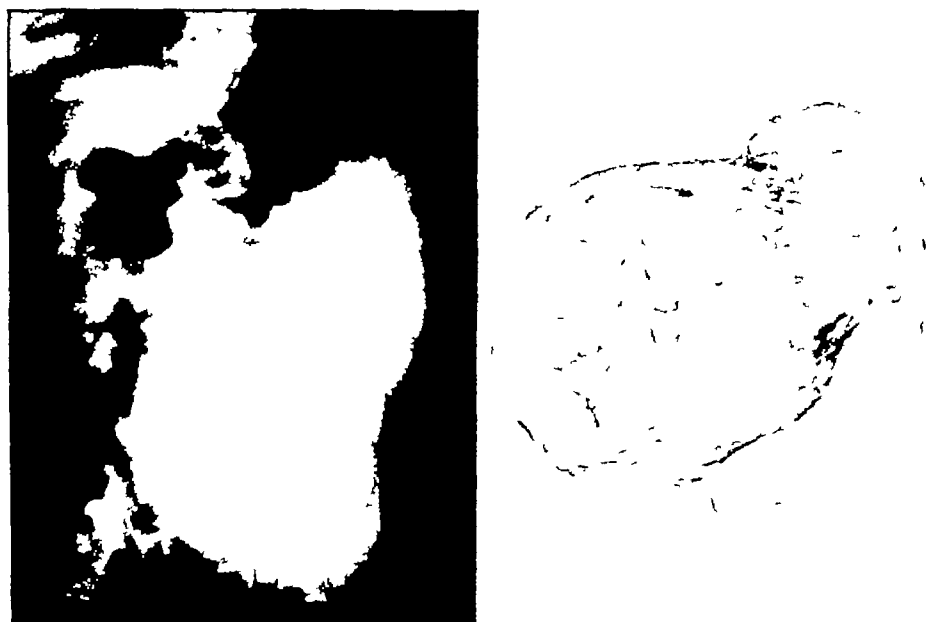
FIG 24 —Hydronephrosis of 850 cc due to aberrant artery to lower pole of left kidney in boy, 4, misdiagnosed Wilms s tumor *Left,* attempt at pyelography *Right,* specimen removed at nephrectomy Recovery

5 *Blood Vessels* —The blood vessels which interfere most often with the outflow of urine and cause hydronephrosis are the aberrant renal artery or the arteries to the lower pole of the kidney They are a much more common cause of hydronephrosis than is generally supposed Arteries crossing the ureter at lower levels can also produce hydronephrosis (Figs 22 to 24)

6 *Inflammatory Changes.*—It is strange how often a ruptured appendix is overlooked and how frequently it sets up hydronephrosis

In the female certain pelvic infections encroach on the ureter and cause hydronephrosis Sometimes the healing process of all extrinsic inflammatory mechanism involves the ureter in scar tissue and produces more or less chronic partial obstruction Hydronephrosis is sometimes secondary to a perinephritic abscess when the abscess presses on the ureter and obstructs it
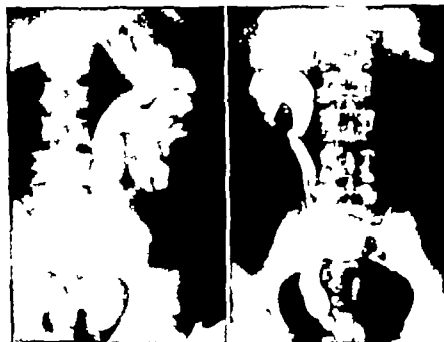
FIG. 25—Congenital solitary kidneys with hydronephrosis and hydro-ureter *Left* capacity 3,000 cc. (about 3 qt.) After drainage by nephrotomy the kidney recovered and patient was well 10 years later *Right* hydronephrosis and hydro-ureter due to obstruction by abscessed seminal vesicle Patient well after 20 years

7 *Floating Kidney*—The hydronephrosis produced by floating kidney was touched on in Chapter 5 Kidney ptosis may be common, but rarely causes hydronephrosis

8 *Trauma.*—It is doubtful that there is such an entity as acute traumatic hydronephrosis. Trauma to the kidney may be the remote cause of hydronephrosis When there is injury to the kidney with actual rupture, immediate surgery is important. Removal of the

clot and repair of the break in the kidney effectively prevents formation of hydronephrosis later In a large number of ruptured kidneys treated by nonoperative means, we have seen hydronephrosis develop later

Childhood injuries to the kidney are particularly important, for we have seen hydronephrosis develop later in life as a direct result of such injury Trauma to the bladder directly or as a result of fracture of the pelvis with consequent injury of the ureter and urethra may cause hydronephrosis during healing

9 *Prostatic Hypertrophy*—This is, generally speaking, a disease of the aging male The associated hydronephrosis is bilateral and involves the ureters also It is usually a part of the general picture and is not as important as the obstruction which causes it Many factors contribute to the creation of renal failure with, in many instances, accumulation of the waste products in the blood stream Both benign and malignant forms of prostatic hypertrophy may cause obstruction at the bladder neck (See Chapter 14)

10 *Diverticula of the Bladder*—A diverticulum of the bladder may at times produce a constriction of either or both ureters and may also cause obstruction at the bladder neck that closely resembles prostatism Such a cause of hydronephrosis would be discovered on routine cystoscopy, and intravenous urography might also disclose the diverticulum Special stereoroentgenograms made after filling the bladder with a solution of 4 or 5 per cent sodium iodide are of great help The medium must not be too opaque (not over 7 per cent) lest the diverticulum be blotted out. If the medium used to make stereocystograms is not too dense, one can see into the bladder, as it were, when plates are placed in the box for visualization

Another cause of hydronephrosis is diverticulum of the female urethra, a not rare pathologic entity Obstruction is sufficient to require considerable force to empty the bladder

NEUROGENIC CAUSES—We now enter a field that presupposes a complete knowledge of the nervous mechanism of the body as it relates to the innervation of the kidney pelvis and ureter There is

no really simple explanation for what takes place in the kidney pelvis as a result of faulty innervation. We are certain, however that some spinal cord lesions, such as spinal cord tumor sclerosis and tabes, produce the typical "cord bladder" The various disorders arising from this type of paralysis of the bladder in turn produce

FIG. 26—Congenital absence of sacrum with attendant nerve disturbances. Bowel and bladder atonic also bilateral hydro-ureter and hydronephrosis.

hydro-ureter and hydronephrosis (Fig. 26) Certain types of hydro-ureter and hydronephrosis found in children who die in infancy are classed as neurogenic because no obstruction can be found as the cause. It is supposed that the walls of the ureter and kidney pelvis lack the proper nerve supply to maintain the muscle and tissue tone necessary to preserve the normal physiology and anatomy of the parts. Neurogenic changes are only rarely the direct cause of hydronephrosis.

ENDOCRINE CAUSES—The work of Jenkins and his co-workers at Yale has given a new point of view on the causes of dilatation of the ureters and subsequent hydronephrosis which take place during pregnancy This complicated disorder, discussed in Chapter 3 under "pyelitis of pregnancy," could as well have been named "hydronephrosis of pregnancy" If the resulting hydronephrosis does not become infected and therefore no pus appears in the urine, the disorder passes unrecognized It has been shown that the ureters of all women dilate during pregnancy Jenkins has shown that the hormone responsible for this condition resides in the placenta, but we await further experimental proof What to do to counteract the influence of the placental hormones (which are still unknown) is in the hands of the research workers

PATHOLOGY—Hydronephrosis must be distinguished from polycystic disease of the kidney and large solitary cysts or multiple cysts Pyonephrosis is often confused with hydronephrosis, unfortunately this disease entity is not clearly understood and classified by the pathologists An infected hydronephrosis is not truly a pyonephrosis

The whole function of the kidney is altered by the changes that take place during dilatation of the pelvis Dilatation may vary in excess capacity from a few cubic centimeters to several liters Damage to the renal structure is in direct proportion to the volume of fluid Therefore the earlier hydronephrosis can be diagnosed and its cause found and corrected, the more kidney tissue can be conserved

In hydronephrosis, stretching of the renal pelvis and parenchyma causes some of the blood vessels to be elongated and some foreshortened Both veins and arteries are affected Because of this process, the blood supply to both the interstitial and the nephronic or filtering portion is definitely deficient This results in a change in the product of the nephrons (p 62) so that the urine is more dilute and some of the normal elements of the urine are lacking Important waste materials like creatinine and urea fail to pass the glomerulus in normal quantities so that the urine in the kidney contains

only water and salt. This throws the excretory load on the opposite kidney. When hydronephrosis is bilateral this may lead to grave systemic complications. There is no way to restore or replace damaged kidney tissue. Once out of function and damaged a nephron
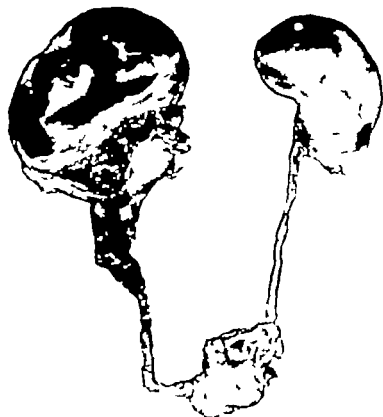
FIG. 27—Hydronephrosis in a dog, from partial obstruction of the ureter. After 45 days, the kidney was almost completely destroyed.

is never replaced. In hydronephrosis the nephron itself is changed from a looping, tortuous tube to a nearly straight one. Thus its function of reabsorption is interfered with and the character of its excreted urine markedly altered. The tubules straighten and collapse first, then the glomerular tuft is affected. The glomeruli continue to function after the tubules cease to perform. Blood often appears in the dilute urine at this stage owing to glomerulonephritis. At

this stage there is no cure, and nephrectomy is indicated if the opposite kidney is good The end-result of hydronephrosis is a fibrous sac filled with a watery substitute for urine—a useless and functionless organ

SYMPTOMS —In many instances the patient is unaware of a kidney disorder. Symptoms may be so vague and unrelated as to mislead the physician As in all obscure disorders in which diagnosis is difficult, a complete urologic examination, with special reference to the kidneys, often solves the difficulty With the onset of acute hydronephrosis, many symptoms may appear at once The patient may have pain over the affected loin or, more commonly, in front just under the costal margin There may be prostration Fever to 103 to 105 F. may be present, with chills probable as an accompaniment. The leukocyte count may rise to 14,000 to 50,000 There may be vomiting and gastric distress When an acute ureteral obstruction is the primary cause, no urine comes from the affected kidney, so there may be no abnormal urinary findings No doubt many such cases have been misdiagnosed, fortunately most of these cases terminate favorably when the obstruction is relieved and the kidney drains normally Usually when this happens the urine suddenly becomes fouled with blood, pus and thick stringy mucus, then quickly clears and the patient recovers promptly

The symptoms of chronic hydronephrosis are different, for the onset is slow and insidious Not until the obstruction is more or less permanent and the hydronephrosis large does the patient come to the doctor for relief The patient will often come after discovering a "tumor" in the upper part of the abdomen, with no other signs or symptoms It is then up to the physician to decide whether this "tumor" is intraperitoneal or extraperitoneal, benign or malignant

Pain may be the solitary symptom If this occurs in a young person and the history is that of regularly recurring attacks dating back to childhood, one should think of hydronephrosis due to aberrant renal artery The character of the pain should be studied Sometimes it is

severe and colicky and at other times it is a dull throbbing ache.

The reflex symptoms produced when the large dilated kidney presses on some structure such as the second portion of the duodenum are varied. Gastro-intestinal symptoms may be prominent. Vomiting and nausea, with distention and rigidity of the abdomen, may mislead the examiner into suspecting an intestinal obstruction or acute appendicitis with unorthodox symptoms.

The patient may describe the "tumor" as transitory that is it comes and goes. For a few days it is present, then disappears for a few weeks or months.

Hematuria may occur and be rather massive There is nothing to distinguish this type from that which occurs with papilloma of the bladder or tumor of the kidney

As long as the chronic or recurring type of hydronephrosis remains uninfected, the clinical picture is not very complicated. With infection, the entire character of the disease is altered. The patient may be extremely ill because of the retained infected urine, some of which is reabsorbed. When the true condition is suspected and a urologic examination confirms the tentative diagnosis, drainage by a ureteral catheter is wise. After emptying the hydronephrotic kidney the ureteral catheter should be secured in place so that it drains the hydronephrosis continuously This gives time to study the case, the symptoms will subside and the patient's condition will improve.

DIAGNOSIS.—The shrewd clinician can suspect the diagnosis on the basis of the signs and symptoms. Proof must await urologic study The clinical history and examination of the patient are no less important here than in any other condition.

It is not always easy to tell by palpation and examination of the abdomen whether a "tumor" is intra-abdominal or intra retro- or extraperitoneal. If the "tumor is large, as some hydronephroses are, there may be no overlying bowel to make a tympanitic sound on percussion and one finds only an area of dulness.

Differentiation must be made from ovarian cysts on a long ped

icle When the hydronephrosis develops in a floating kidney and is on a long pedicle, it can be distinguished only by pyelography A large spleen and intestinal tumors, particularly of the mobile cecum, must be ruled out When the condition is suspected, the next step is to make intravenous pyelograms If these confirm the tentative diagnosis, a full urologic examination is made With all the evidence assembled—history, physical findings, laboratory data and urologic and roentgen observations—one can arrive at the correct diagnosis and outline the treatment

TREATMENT—The first consideration always is to deal with the causative agents If the hydronephrosis is bilateral and involves the ureters, the problem must be carefully studied before surgery is attempted

When bilateral hydronephrosis is not the primary condition, the whole procedure must be altered For example, for hydronephrosis and hydro-ureter which sometimes occur with chronic bilateral renal tuberculosis, little can be done Also, hydronephrosis which affects both kidneys and ureters in the late stages of carcinoma of the cervix or uterus presents a baffling problem Here one may do bilateral nephrostomies or ureterostomies

Most cases of hydronephrosis in children are amenable to surgery to relieve the obstruction This obstruction, as previously mentioned, may be of any variety from a congenital valve in the posterior urethra to an aberrant blood vessel crossing the ureteropelvic junction

Pyeloplasty is plastic surgery on the pelvis of the hydronephrotic kidney There are many variations In the case of an impacted stone in the ureter, surgical removal of the stone may cure the hydronephrosis Tumors in the ureter present a more complicated problem and the choice of procedure becomes a matter of experience and judgment.

In young children with large bilateral hydronephrosis, we immediately perform bilateral nephrostomies In this way the pressure damage to the young kidney is stopped and recovery begins After

the child has returned to normal in every other respect, complete studies can be made. Functional tests will reveal the recovery status of the kidneys. When full function has been restored and pus is not present in the urine, further studies will show how nearly the contour of the kidney pelvis approaches normal. After the kidney has recovered, the surgery necessary to correct the obstruction should be undertaken. After that, one nephrostomy opening should be allowed to close so the urine will again flow through normal channels. When all tests show satisfactory progress, the second nephrostomy should be allowed to close.

PROGNOSIS.—That two kidneys supply twice the filtering area of one is obvious. Conservation of kidney tissue is good surgery Sometimes in trying to conserve kidney tissue, infection is introduced or an old infection revived, so that in the end the kidney must be removed. Good judgment, plus experience still has no substitute. The person who has a 75 per cent reduction in kidney function is a cripple He cannot stand the hard knocks of life He tires easily and is subject to many minor ailments His chances of developing hypertension, coronary sclerosis and heart disease are much greater than the person with normal kidneys at the same age. When function of a kidney in unilateral hydronephrosis can be restored and the other kidney is normal, the patient has an even chance of good health.

8

Tumors and Cysts of the Kidney

BEFORE THE time of Gustave Simon (1824-1876), renal tumors were seen only in the dead house. Much has been added to our knowledge in the intervening seventy-odd years since that epoch-making surgical event in 1869, when Simon planned and carried out an operation for removal of a kidney.

To the average medical man, a survey of all the books, articles and classifications of renal tumors would be most confusing. The literature is cluttered with meaningless classifications and minutiae. If the physician knows too much about the rare lesions, he may miss the common ones, and thus his diagnostic batting average may suffer.

It was refreshing after reviewing much data to open *Surgical Anatomy of the Urinary Organs* by our old teacher and friend, the late Hertzler of *Horse and Buggy Doctor* fame, and to see a simple working classification of kidney tumors. He commented "If the surgeon comprehends the four chief lesions listed below, he is not likely to miss anything of importance and very little of purely scientific interest." Here is his classification (1) adenocarcinoma, (2) hypernephroma (fetal adenoma), (3) teratoma of infancy and childhood, (4) tumor of the renal pelvis and ureter.

For our purposes, we prefer the following modification

1. Adenocarcinoma
2. Hypernephroma (fetal adenoma)
3. Tumors of the renal pelvis and ureter

4. Benign tumors of the kidney

5 Cysts of the kidney

6 Tumors of childhood and infancy—malignant, benign, cysts

Probably pathologists and kidney surgeons would not agree to this classification, for it is not all-embracing However it is simple and thus avoids confusion.

Knowledge of these tumors is less than a hundred years old. It is reasonable that tumors arising from a complicated structure like the kidney should, in themselves, have a complicated make-up The perplexity of the pathologist in the study of renal tumors is reflected in the detailed classifications, the disagreement as to names and the endless discussion of their origin. Volumes have been written on the cellular pathology of the different types of renal tumors. Here we wish to avoid the study of the microscopic cellular structure and consider these malignant growths from the standpoint of the clinician.

Adenocarcinoma

The term or prefix *adeno* indicates that the tumor is somehow related to glands or gland structure. An adenocarcinoma is made up of a series of glandlike groups of cells. Those derived from the kidney arise largely from the tubular epithelium. Generally the gross appearance of the tumor permits its classification as nearly as the microscopic section. Usually these tumors are small hard growths although some seem to proliferate into large spreading masses which tend to invade all contiguous structures.

As a rule they metastasize early Metastatic nodules are often found in the liver Sometimes the lung is the first distant organ invaded. The retroperitoneal and mesenteric lymph nodes are often invaded. These growths spread by the lymphatic system.

Hypernephroma

The name hypernephroma is derived from the belief that these tumors arise from adrenal rests in the capsule of the kidney Controversy still centers on these particular malignant renal growths.

Before Grawitz' (1850-1932) epoch-making report, these tumors were considered separately from cancers and were called "fatty yellow tumors of the cortex." Grawitz called them *Strumae super-*
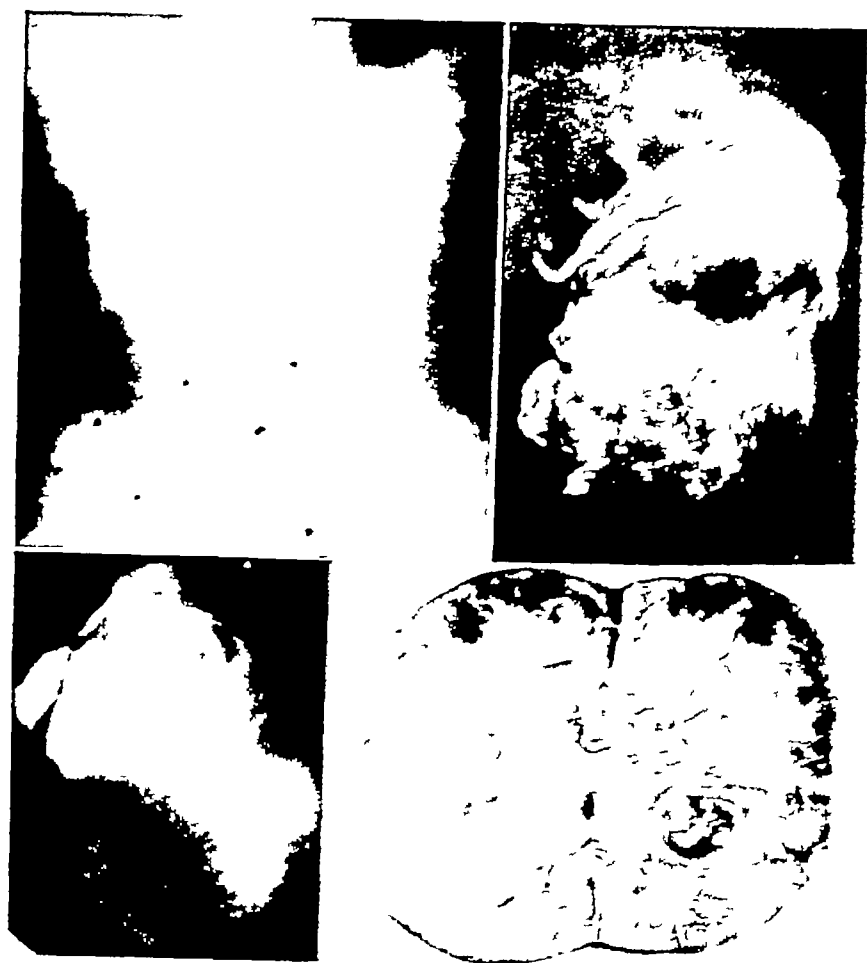
FIG 28 —*Upper left,* typical deformity of kidney tumor—hypernephroma, *upper right* kidney and tumor removed at operation, *lower left,* roentgenogram of specimen filled with bismuth. *Lower right,* very early hypernephroma of the kidney, the tumor itself being 3 cm. in diameter

renales abberrantes renalis. His theory gained acceptance among the German pathologists, who soon called these tumors hypernephromas or Grawitz' tumors. Other pathologists do not accept the adrenal rest theory, although agreeing that these tumors are
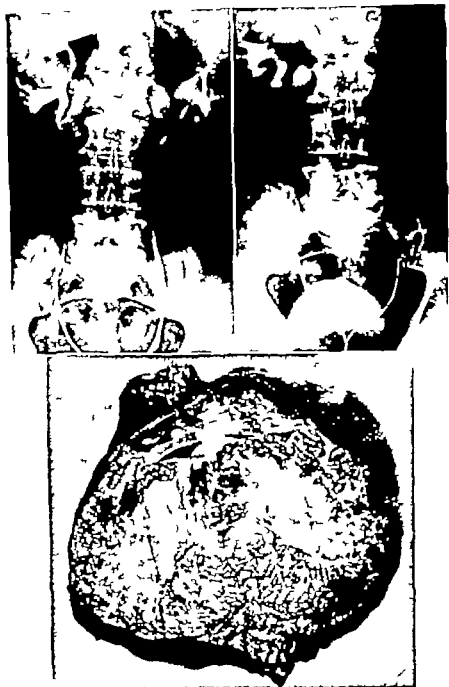
FIG. 29 —Hypernephroma. *Upper left* first roentgenogram. *Upper right* second roentgenogram, 10 years later *Below* tumor removed. Later pulsating tumor from the forehead proved to be a hypernephroma. Patient is alive 15 years after discovery of tumor

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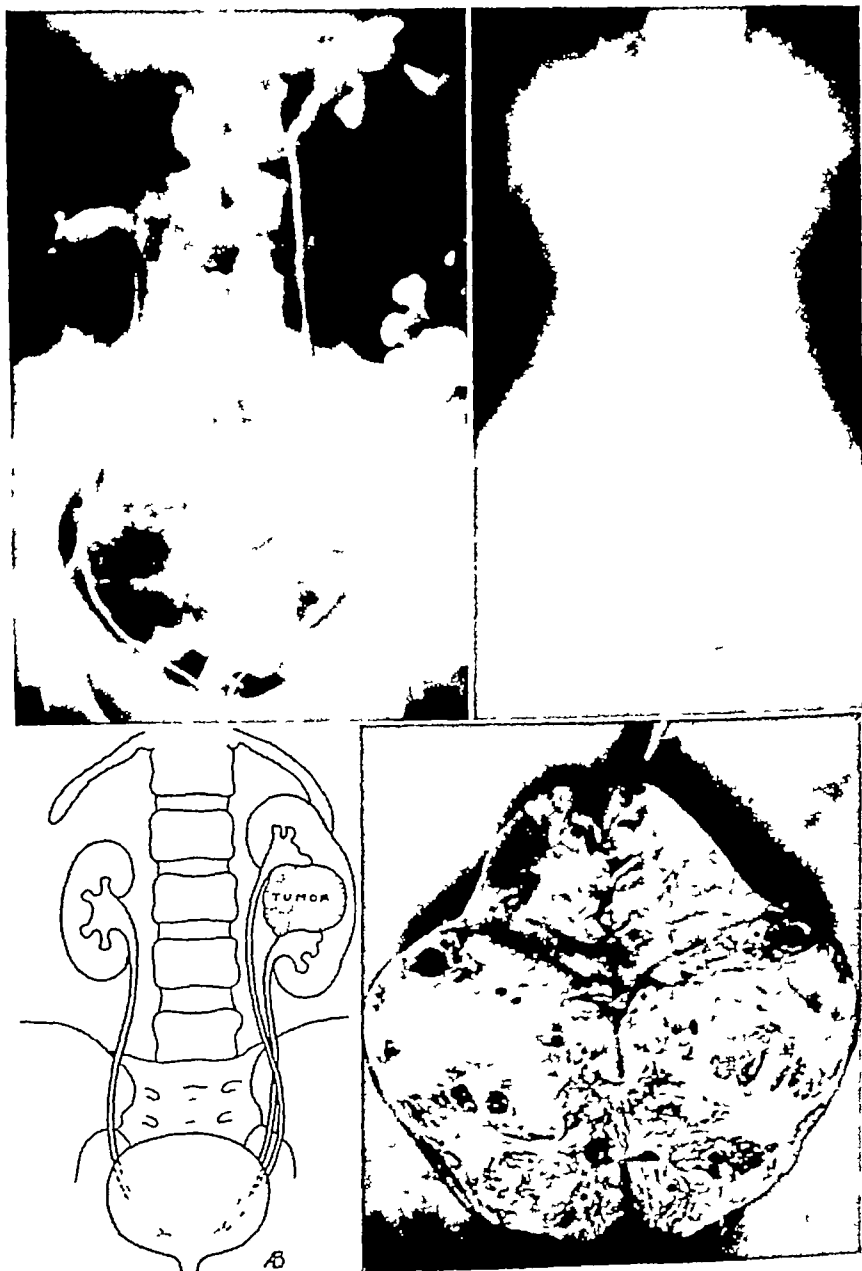
FIG 30 —Hypernephroma in double kidney, in midportion between the two pelves *Upper left,* pyelogram made with ureteral catheter in upper pelvis of the double kidney, *upper right,* pyelogram made with catheter in lower pelvis *Lower left,* diagram of condition *Lower right,* specimen removed at operation.

unlike cancers of the kidney of the glandular type Clear cell car cinoma and hypernephroid tumor are other names used to desig nate the same tumor No matter what the name or the origin, the

FIG. 31—Rare type of papilloma of renal pelvis. Symptoms were those of obstruction, with fever and pain in right kidney region. *Left* pyelogram sug gesting tumor Completely obstructed kidney filled with blood was removed. *Right* papilloma in lower part of pelvis, completely obstructing flow of urine, with kidney totally destroyed. The patient is well 10 years later

tumor remains distinctive and is the commonest of kidney tumors.

Their natural history suggests that they are different from all other kidney tumors There is no question of their malignancy but there is doubt as to when they become malignant. They show many characteristics suggesting origin from immature or undifferentiated cells. The growths tend to encapsulate which is not characteristic

of a highly malignant cancerous growth It is true that they break through the capsule and metastasize by invading blood vessels We reported a case in which diagnosis of kidney tumor was made 10 years before we saw the patient, by another doctor We confirmed the diagnosis by comparing the roentgenograms made 10 years before with those we had just made (Fig 29) The tumor was removed, and the man was alive and well five years later Some time after the nephrectomy he had a pulsating tumor on his forehead which, on removal and examination, proved to be a "hypernephroma" In this case, the kidney tumor must have been several years old before the original diagnosis was made

Tumors of the Renal Pelvis and Ureter

Practically, only two types of tumor are found in the renal pelvis papilloma, and squamous cell neoplasms

The papilloma in the kidney pelvis is identical to that commonly seen in the bladder (Figs 31 and 32) Indeed, some believe that bladder papillomas are implants from growths in the kidney pelvis or ureter This probably does occur in rare instances since these neoplasms spread by implantation

Papilloma of the renal pelvis is rare It is not to be confused with papillary carcinoma which arises from the renal tubules Probably not more than 200 cases of papilloma of the renal pelvis have been reported Formerly the lesion was discovered at autopsy or was a surprise finding when a kidney was removed for persistent bleeding Since these growths are identical with those in the bladder, the reader is referred to Chapter 13, where a full description of these lesions is given

Squamous cell growth of the kidney pelvis, of which the reported cases number less than 100, has never been diagnosed clinically It is enough to mention them in passing

Benign Tumors of the Kidney

The term "benign" as applied to tumors has always seemed to us inappropriate The pathologist, in using this term, perhaps in-
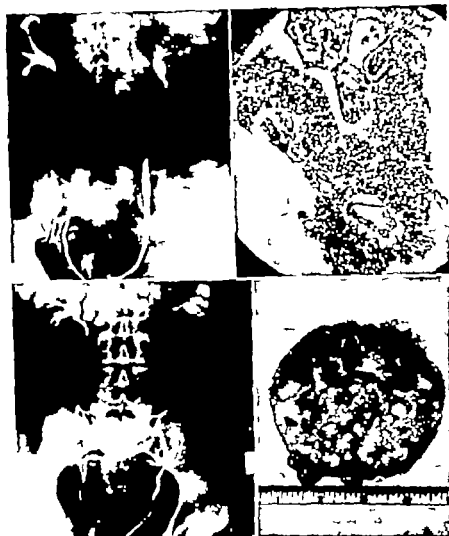
FIG. 32.—Papillomas of the renal pelvis. *Upper left* well advanced case, diagnosed from pyelogram and characteristic hematuria. Patient died of metastases a year after nephrectomy *Upper right* section of this tumor showing typical papillary arrangement of malignant cells. *Lower left* papilloma treated as pyelitis for two years. Characteristic hematuria was not present, and diagnosis of papilloma was uncertain from pyelogram. Patient died of lung metastases 14 months after tumor (*lower right*) was removed.

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tends to imply that the tumor is less serious than malignant tumors and that it is not immediately dangerous to life Long usage has accustomed us to a meaning of the term that is the antithesis of malignant

The benign tumors fall into three groups (1) adenomas, (2) fibromas and myomas, and (3) lipomas They constitute not
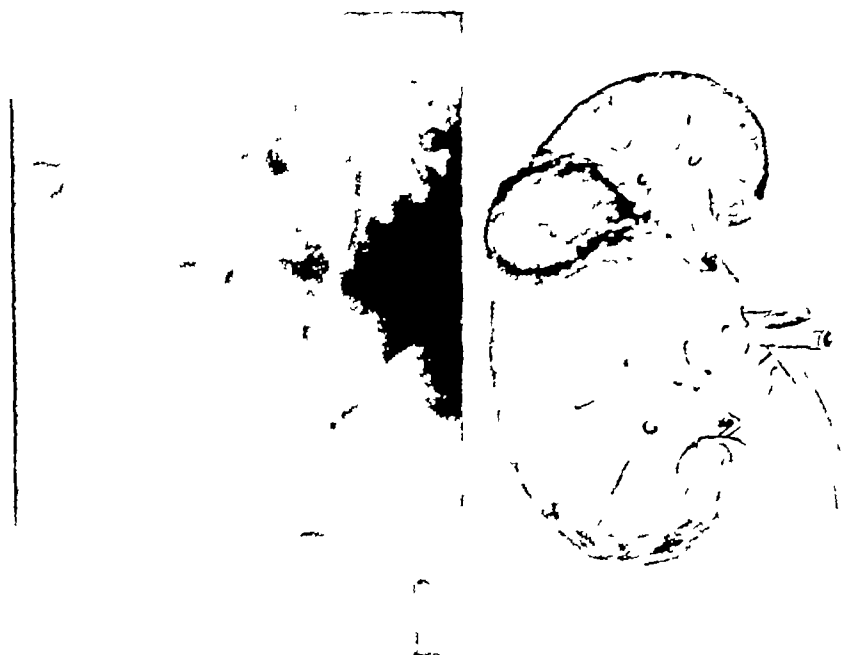
FIG 53 — Malignant papillary cystadenoma in a double kidney There was bilateral reduplication of kidneys and ureters

over 2-4 per cent of all kidney tumors, so are relatively unimportant clinically Furthermore, there is no way of differentiating a benign from a malignant tumor clinically

Adenomas —Were it not for the fact that these seemingly innocuous tumors are thought to be capable of changing into other and malignant forms, they would not be of much importance They are often an incidental finding in the kidney at autopsy They appear as small spherical, yellowish or yellow-gray growths near or just under the capsule Those that become large are diagnosed as kidney tumors and removed surgically They probably arise from

the tubules of the kidney and present several variations in form alveolar tubular papillary cystic, and combinations of these (Fig 33)

Myomas and Fibromas —The myomas, or muscle tumors are also rare, constituting only a small percentage of kidney tumors. By muscle tumors we do not mean tumors arising in muscles but tumors which on microscopic section show unstriped muscle tissue

FIG. 34 —So-called solitary cyst of kidney The very large cyst practically split the kidney in its long axis exceedingly small cysts were also present, several of which are seen on the surface of the kidney

Fibromas, or tumors composed of fibrous or connective tissues, are also rare.

Lipomas —Fatty tumors are exceedingly rare and are always a surprise finding at operation. They are as the name implies, composed of fat globules and fat masses They may be small or may attain large size.

Cysts of the Kidney

Only a few types of cysts occur in the kidneys (1) solitary large cysts—(*a*) serous, (*b*) hemorrhagic; (2) multiple large cysts (3) pararenal cysts (4) polycystic disease

Solitary large cysts are rather uncommon (Fig 34) They are usually serous and contain straw-colored fluid. They seldom in
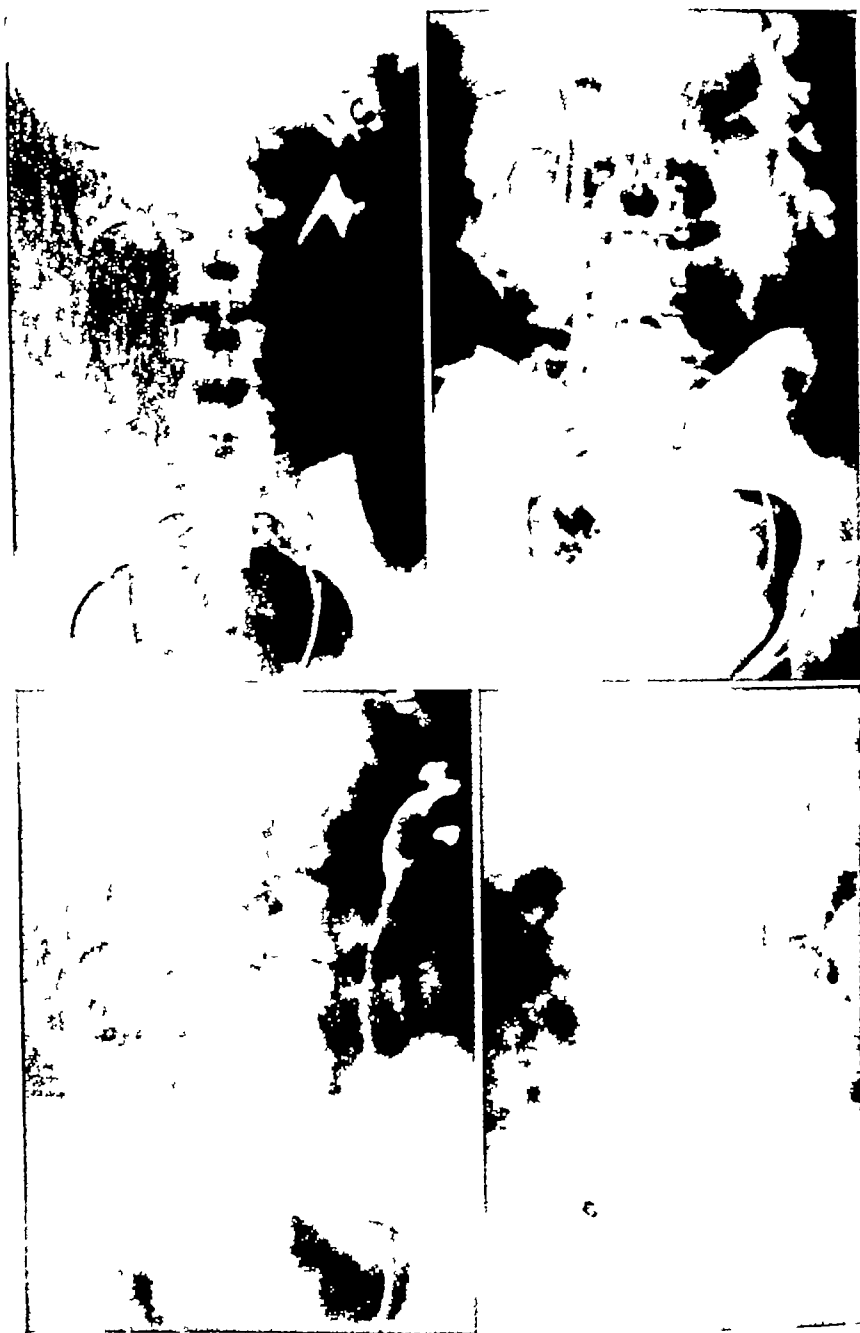
FIG 35 —Polycystic disease of the kidneys *Upper left,* in girl, 13, now mother of three children. *Upper right,* in woman, 54, apparently of long standing *Lower left,* in man, 62 *Lower right,* in woman, 30, who just previously had eclampsia of pregnancy, later diagnosed nephritis She lived 10 years, with blood pressure rising to 300, and died in renal failure

volve or communicate with a calix, but recently attention has been called to cysts which seem to originate in a minor calix obstruction and communicate with the kidney through a tiny tortuous lumen.

Sometimes several large cysts in each kidney apparently cause no symptoms and do little harm. They are usually discovered on routine examination or at autopsy. Some cysts attach themselves to the outside of the kidney in the pararenal area. Those which do should be called retroperitoneal cysts, for they are not true renal cysts.

The most important category is polycystic disease of the kidneys. It usually involves both kidneys. It is sometimes designated "congenital bilateral polycystic disease." The kidneys are filled with multiple cysts varying in size from a fraction of a millimeter to several centimeters in diameter. The cysts are filled with a watery serous fluid. Practically all the parenchyma is replaced by these cysts. Unless it is possible to palpate the kidneys through the abdominal wall the diagnosis will not be clear and the patient will probably be treated for chronic nephritis until autopsy proves the true nature of the disease. The only other bilateral renal tumor (in adults) felt through the abdominal wall is the rare bilateral hypernephroma (less than 35 cases in the literature).

Polycystic disease is called congenital because cystic kidneys have been discovered in the fetus as well as in the young child. There seems to be a definite hereditary tendency with several family groups on record. All advanced cases show marked diminution of function in dye tests. More than half of the patients have increased blood pressure at the time of diagnosis. The symptoms become those of kidney failure from nephritis. Perhaps a third of the patients have intermittent hematuria. Some have continuous intractable pain. We have operated on three patients puncturing large cysts, with temporary relief from pain.

The characteristic pyelogram can scarcely be mistaken (Fig 35). On rare occasions the disease is confined to one kidney or one kidney attains enormous proportions while its fellow remains nearly

normal size In one such case, the patient complained of a "tumor" in the left upper quadrant, and we operated, removing the left kidney which was completely replaced by cysts (Figs 36 and 37)
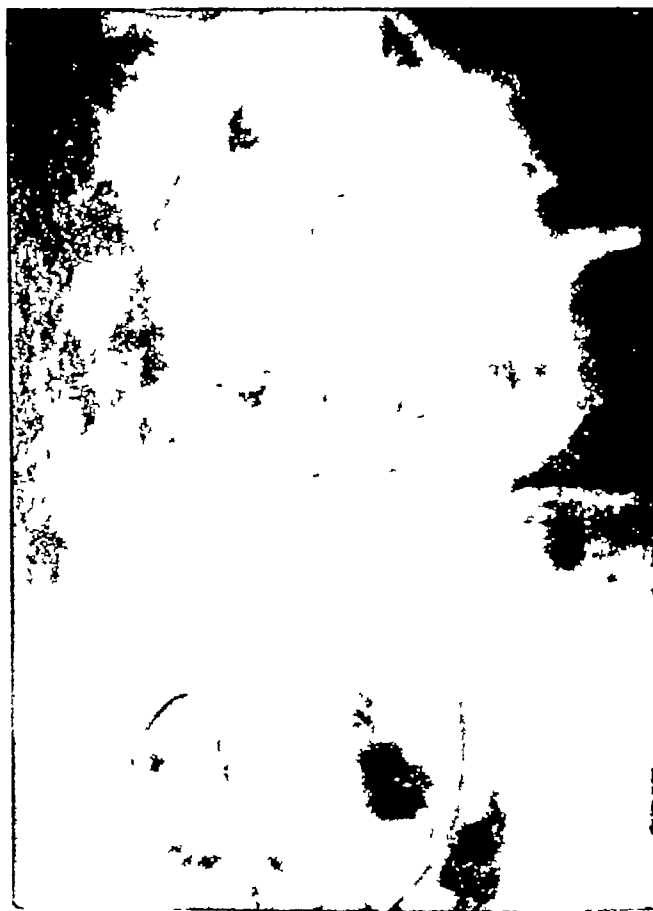
FIG 36 —Unusual case of polycystic disease involving only the left kidney Large mass in the left upper quadrant was suspected of being a renal tumor Section of the enormous mass revealed a polycystic kidney Patient is well after 17 years, and remaining kidney appears the same (See Fig. 37)

The right kidney was nearly normal This patient has been well for 17 years and the remaining kidney still functions normally

DIAGNOSIS —The history is less important in the diagnosis of renal tumor than in many other diseases, although it is imperative to take a complete history for it may have an important bearing on complicating diseases One or more of the following signs and

symptoms usually bring the patient to the doctor hematuria, pain, tumor fever weakness, loss of weight digestive disturbances and gastro-intestinal disturbances.

FIG. 37 —Same case as preceding. Polycystic kidney removed at operation.

Although hematuria has been designated one of the cardinal signs of kidney tumor only about 50 per cent have gross hematuria as an important symptom. The blood coming from a bleeding tumor of the kidney may look the same as that coming from the bladder

in cases of papilloma When there are wormlike clots that have been molded to the ureter and the patient tells of colicky pain in the ureteral area during or preceding the hematuria, one should at least think of kidney tumor

Often the patient finds his own tumor and the physician must be familiar with other abdominal tumors to narrow the diagnosis
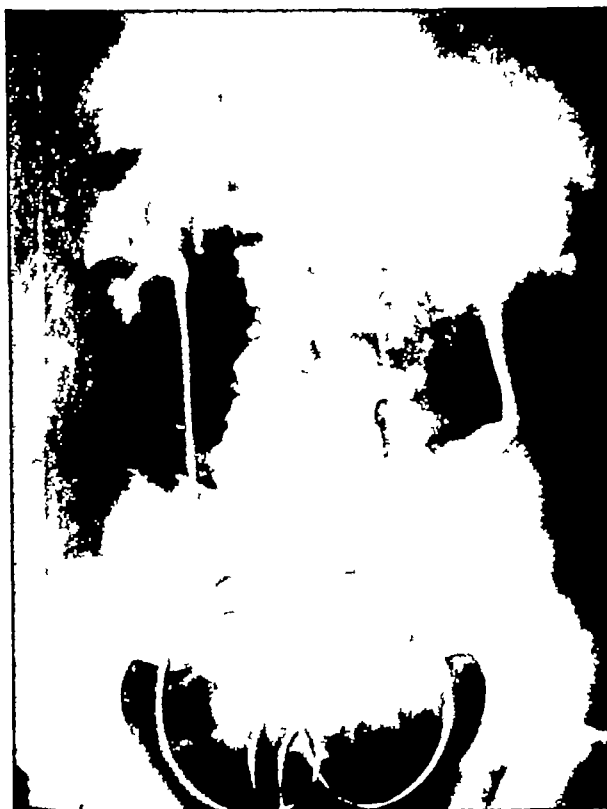
FIG 38 —Retroperitoneal tumor which displaces kidney forward

When there is associated hematuria, the tentative diagnosis is clear The first and most important symptom may be pain in the area of the affected kidney

We have long taught students that there are four clinical types of kidney tumor hematuric, painful, tumor and fever type The last. the fever type, is not often recognized The tumor itself gives rise to fever and when the tumor becomes uniformly infected, fever

results. The temperature is seldom over 101 F When hematuria, pain, tumor and fever occur in the same patient, a presumptive diagnosis can be made from the history alone.

Weakness and loss of weight usually occur with tumors that are highly malignant and metastasize early The tumor may be small The weakness is due to the toxemia induced by the tumor by loss of blood and by fever Gastro-intestinal symptoms may dominate the picture if the tumor is large enough to involve by pressure or otherwise an intraperitoneal organ such as the duodenum, stomach or portion of the large bowel

Physical examination should be thorough. In about half the cases a tumor cannot be made out by palpation of the abdomen. Some times, however, the tumor can be readily seen through the abdominal wall. Urologic studies should be undertaken as soon as a kidney tumor is suspected.

Complete cystoscopic studies should be made including urine from separate kidneys Kidney function tests and pyelographic studies should be made From a study of the history physical findings and results of the urologic examination, the diagnosis can be established.

However the exact variety of tumor cannot often be diagnosed. The malignant tumor produces the same shadows on the roentgen plates as the benign tumor Cysts can sometimes be diagnosed from the x ray plates by their large characteristic displacement. Polycystic disease, which is almost always bilateral, must be differentiated. Other abdominal tumors, such as ovarian cysts large fibroids of the uterus, tumors involving the liver stomach, omentum or pancreas, enlarged spleen, floating kidney and kidney anomalies, must be differentiated.

TREATMENT—The treatment of renal tumors is surgical As soon as the diagnosis is established, a survey should be made to see if operation is possible There are many inoperable tumors. When a tumor is bilateral there is no particular use in operating. Extensive metastases contraindicate surgery

The patient may show signs of systemic breakdown, with cachexia, low hemoglobin content, loss of weight, weakness and loss of appetite In these cases, the tumor is often too far advanced for operation When a urologic survey shows that the other, presumably good, kidney does not have sufficiently normal function to carry on life, operation had best not be undertaken

Operative mortality is not high Roentgen therapy is sometimes advisable to reduce the size of a huge tumor and nearly always as an adjunct to surgery Roentgen therapy should be given in courses under the direction of a competent therapist The results of surgery of cysts and benign tumors are much more encouraging

Tumors of Infancy and Childhood

Children are subject to all the tumors that afflict adults All but one of the list are rare The so-called Wilms tumor is the usual kidney tumor in children under 7 Marx Wilms (1867-1918) wrote a classic description of this tumor, which bears his name (Figs 39-41)

Under Wilms's tumor are included lipomyoma, chondromyosarcoma, adenosarcoma, rhabdomyoma, myosarcoma, embryonal sarcoma, spindle cell sarcoma and fibromyosarcoma These tumors spring from embryonal cells having totipotent powers, so the three germ layers are represented in the tumor Occasionally the pathologist reports these growths as embryonal carcinomas because he saw the ectodermic proliferations in the sections They are essentially teratomas

CLINICAL PICTURE —Not only are Wilms's tumors the commonest neoplasms of the abdomen and retroperitoneal space, including the kidney, but they comprise 20 per cent of all tumors in children More than 60 per cent appear before the age of 3 years After the seventh year, Wilms's tumor is rare and the tumor which may occur is the hypernephroma of the adult Since Wilms's tumors have been found in fetuses as early as the sixth month, the tumor has been called a congenital sarcoma It is not uncommon in the new-born

FIG. 39—Wilms tumor *Above* in woman 54 *Lower left* pyelogram of child, and *(lower right)* tumor removed at operation.

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kidney tumor on record, probably because the tumor is nearly always well advanced when discovered In defense of those who fail to make early diagnosis, it can be said that these tumors have rapid growth and attain large size in a few weeks

PATHOLOGY —One characteristic of the Wilms tumor is that it seems to arise from the capsule of the kidney, and apparently hanging on the side of the enormous tumor is three quarters of a normal-appearing kidney Frequently this normal kidney is displaced downward into the pelvis, across the midline to the opposite side or up under the diaphragm

When the tumor is opened it has a soft, gelatinous, brainlike consistency It is easy to see why the older observers called them "encephaloid" tumors of childhood Just where they metastasize first is not of much importance The point is that if they metastasize anywhere, they are rapidly fatal The microscopic picture is so confusing that the pathologist cuts blocks from several portions of the specimen and tries to make a composite report of all he sees This accounts for the multiplicity of names of these tumors They often break down and become degenerative, unrecognizable masses If roentgen therapy is given before operation, the pathologist will have difficulty deciding what he sees in his sections

The confusing histologic picture of Wilms's tumors can only be clarified by recalling the underlying embryology As mentioned, some believe they are derived from totipotent sex cells which are misplaced during the blastomere stage of kidney development. Wilms subscribed to a similar theory

TREATMENT —There are experts who advocate irradiation of all renal tumors regardless of size or probable pathology We believe only those tumors, adjudged malignant, which are too large to remove comfortably should be treated with x-ray preoperatively All kidney tumors should be removed surgically for pathologic study X-ray therapy should follow but should not begin less than four weeks after operation, otherwise, the wound may break down Roentgen therapy should be given by an expert radiologist.

9

Injuries to the Kidney

THERE ARE three general types of injury to which the kidney is subject (1) injuries of external violence from blows falls or crushing injuries (2) penetrating wounds from bullets or sharp objects (3) injuries incurred during instrumentation with ureteral instruments, such as stone dislodgers, ureteral bougies and stiff catheters, or during pyelography when too much or too strong pressure is used to inject the opaque medium.

There are in the literature many cases and groups of cases of the various types of ruptured kidney There is no doubt that not nearly all such renal injury cases are reported. Available statistics indicate that the injury occurs not oftener than once in 500 injuries of all types. Rupture or injury to the kidney has been recognized by surgeons since ancient times In many cases there is injury to other viscera as well as to the bony framework of the body

In a study of 100 cases taken consecutively from the literature we were able to compile some instructive statistics. It has been generally stated that the injury is more frequent in males, the figure being given as 92 per cent in males We found the incidence to be 85 per cent in males. The reason for this change is apparent when we consider how many women have gone into occupations formerly limited to men. We may look for a further increase in kidney injuries among women.

as soon as his condition will permit, intravenous urography should be done (Fig 42, left) If the outlines of the kidney pelves are clearly portrayed on the roentgenogram and no hematoma is seen, the injury is not dangerous If the pyelogram shows varying degrees of fracture of the kidney, the seriousness and extent of the lesion
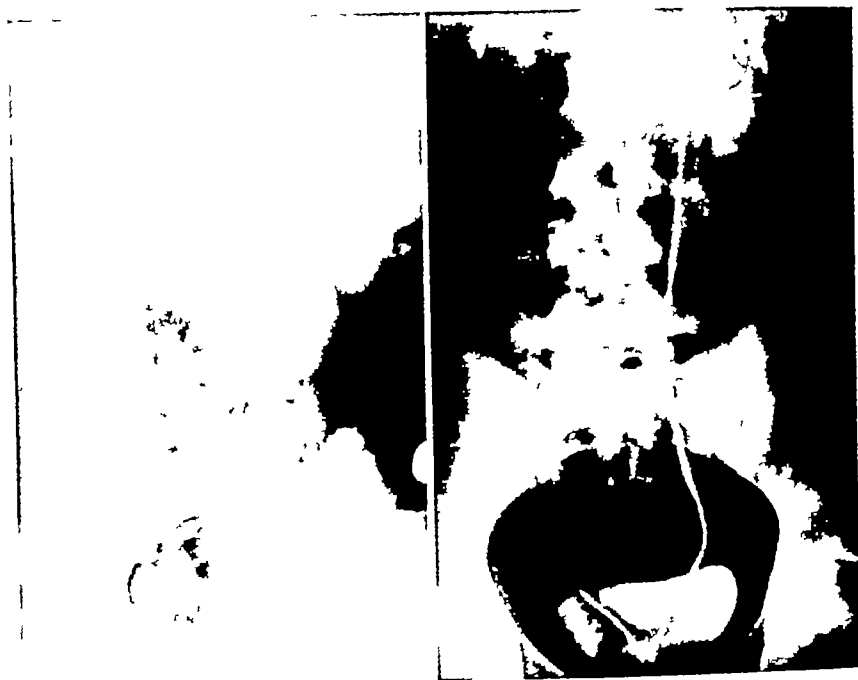
FIG 42 —*Left* ruptured kidney in boy, 15, from football injury Completely severed renal vein necessitated nephrectomy *Right,* remote result of old rupture of kidney When a child, the patient fell, but did not acknowledge being injured until long afterward A surgeon called to operate diagnosed renal tumor, closed the incision and predicted early death The complete story was obtained when, as a nurse, she was examined for the source of pus in the urine The large calcified area in the lower half of the kidney is due to the large blood clot once present

can be estimated correctly The pyelographic film may show the hematoma, for even a small subcapsular hematoma is usually clearly portrayed on the film Large hematomas and urinary extravasation sometimes push aside the intestines in a characteristic fashion Intravenous urographic studies should therefore never be omitted, for they have great diagnostic value If one kidney shows a clear normal

outline and the other shows a smoky undefined mass of opaque medium in the kidney area, one can be almost certain that a serious fracture of the kidney has taken place Roentgen studies must also be made of the bony framework for pelvic, rib and vertebral fractures, for such injuries are not an uncommon accompaniment of renal rupture

TREATMENT —In case of ruptured kidney there is much the physician can do early A patient with a ruptured kidney nearly always suffers from shock, and this must be treated first. This is done in the following manner

1 The patient is put in a warm place and covered with warm blankets. Hot water bottles or electric pads are used. The application of heat should be done carefully for the purpose is to conserve the body heat, not to increase it. Increasing body heat to a point where the patient begins to perspire entails new dangers, such as loss of body fluids, changes in the blood plasma and further fall in blood pressure.

2 Morphine ¼ gr., is given by hypodermic.

The patient may recover from the shock rather quickly Young persons, even though the renal injury is severe, may recuperate rapidly

3 On showing signs of recovery the patient is carefully transported to a hospital where further diagnostic and remedial measures can be carried out.

4. Blood pressure recording should be made at regular intervals.

The next step after treating the shock is to establish the extent and seriousness of the injury for on the completeness and speed with which this can be accomplished may depend the outcome of any treatment instituted later

As soon as possible, the patient should be made to void. If the urine passes easily there is no rupture of the urethra or bladder If he is unable to void within a half hour of the time of the injury a catheter should be passed. Diagnosis of ruptured urethra is made with the catheter if the catheter does not pass readily to the blad

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the costal edge, should be over the break in the table The table is then broken so that the loin is put on stretch

A curved lumbar incision is made beginning at the costovertebral angle and extending down and forward to a point below the anterior superior spine of the ilium This incision should be generous, often 25-35 cm long, so that there will be plenty of room in which to work When the muscle layers—external and internal oblique and the latissimus dorsi—have been incised, a nick is made in the transversalis fascia at the costovertebral angle A yellow fatty fascia will show here, and the finger is slipped into it and pushed down and forward, enlarging the wound by splitting this transversalis layer The fascial envelop of the kidney is carefully picked up with Allis forceps and a small incision made Blood clots and bleeding may be encountered here The hole in the fascial envelop of the kidney is enlarged, the edges are seized with four Allis clamps, and the surgeon pulls up gently on all four clamps, thus bringing the kidney up into the wound Clots are carefully removed The finger is slipped down carefully between the fascial envelop and the capsule of the kidney and the renal artery located If it can be felt to beat, the surgeon carefully dissects until the renal vein can be made out, if these vessels are intact, nephrectomy need not be done

Next, an assistant seizes the pedicle between his index and middle fingers and obstructs the blood supply to the kidney by gently compressing the pedicle Rubber-covered intestinal clamps, sometimes used, are dangerous The clot having been carefully removed and the bleeding controlled by the fingers on the pedicle, repair of the fractured kidney is begun. Several pieces of muscle are prepared, large enough to fill the defect in the kidney If the fracture is a clean one through the middle, some of the pieces of muscle are placed over the line of the break and secured in place with an atraumatic needle and triple 0 chromic catgut. This is covered with fat and the kidney laid gently down in its bed About 5 Gm of sulfathiazole powder is sprinkled in the wound, two cigaret drains are placed and the wound is closed in layers, carefully apposing

separately the four muscle layers, fascia and skin. The patient is
then returned to bed.

Transfusion of 1 000 cc. of blood is started followed by 2 000 cc.
of Ringer's solution with 5 per cent glucose No food or water is
given by mouth for 30 hours. Intravenous administration of fluids

FIG. 43 —Scarred and deformed kidney in girl, 12, with history of ruptured
kidney many years before.

is continued during this interval Then small sips of tap water at
70 to 75 F are given, then tea, jello, broth, dexin and gelatin may
be added. The patient is on a liquid diet for 48 hours, and the
feeding is gradually increased to full diet in three or four days.
Drainage is removed the third day and stitches are removed the
tenth day The patient may be up and about in two weeks

We have recited somewhat in detail an operation for the repair

of a ruptured kidney We wish, in addition, to impress on the p
sician the possible sequelae of failure to operate or of neg
(Fig 42, right [p 162], and Fig 43) That the patient reco
from a ruptured kidney sometimes seems all that is important
the physician That the patient may recover and later becom
kidney cripple is a sad truth The patient may do well for sev
months and finally develop an abscess in the perirenal or rei
peritoneal space which must be drained The kidney is usua
partly destroyed in this prccess Nephrectomies attempted at t
late date are attended with a high mortality rate If no infect
develops the clot may calcify and destroy one half to two thirds
the kidney Hydronephrosis may result from injury to the ureter
from too long-standing pressure of the clot on it, thus obstruct:
the flow of urine Stone in the kidney may develop as a result
the stasis Adhesive bands may form around the kidney and ure
causing slow destruction of the kidney Hypertension may be
remote result of neglected renal rupture

Penetrating wounds from bullets and sharp objects which inju
the kidney must be dealt with in the manner already described

Injuries incurred during urologic examination are generally
interest only to the specialists

Occasionally a practitioner who does some surgery but who dc
not feel entirely comfortable when confronted with a major pi
cedure, such as the exploration and repair of a renal injury, is t
only source of medical aid available in an emergency For this reasi
we have presented the description of the operation in detail

Anomalies of the Genito-Urinary Tract

THIS CHAPTER is in reality the museum of anatomic curiosities It readily becomes the repository for all the bizarre, aberrant, fantastic, strange or rare anatomic variations of the genito-urinary tract. The interest in this subject is not alone one of curiosity but has a genuinely practical clinical aspect.

Anomalies of the urinary tract are, with few exceptions, hidden defects and must be sought from the depths of the interior of the body A knowledge of just what these anatomic aberrations are is necessary to an understanding of the pathologic processes they engender We feel that we must illustrate this chapter completely by line drawings, x rays—both plain and pyelographic—and schematic representations to have this chapter sustain both its teaching value and its practical clinical interest.

Our purpose here is not to see how complicated we can make this subject by crowding every inconsequential and rare anomaly into the text, but to make clinical application of the most important anomalies. It would take many pages of careful explanation to make clear the underlying embryology of all the congenital anomalies of the genito-urinary tract. We can say from a lifetime study of renal and genital pathology that fully one third of renal and ureteral pathology is due to congenital malformations. Nephritis of the various types is, of course, not included in this statement. We will describe briefly all the anomalies in their anatomic order without using space taking tables of classification.

Anomalies of the Kidney

SOLITARY KIDNEY—This anomaly was formerly thought to be rare but carefully studied series of autopsies and clinical cases indicate that one kidney is absent in the ratio of one in every thousand

FIG 44—Solitary pelvic ectopic kidney in young woman, diagnosed six years before death. *Left,* kidney lying transversely in pelvis, with no kidney shadows in normal kidney fossae *Right,* autopsy specimen, weight 40 Gm Uterus had only one horn Death from renal failure

individuals Nearly a thousand such cases have been reported in the literature

In certain cases the solitary kidney is normal in every respect in position, size and functional ability Often the kidney, in addition to being solitary, is ectopic (Fig 44) or misplaced Sometimes it is on the opposite side, the ureter crossing over obliquely, and it may be down in the pelvis (Fig 45).

The solitary kidney which is normally placed has the best chance of remaining healthy. The ectopic or misplaced kidney develops disease in a high percentage of cases.

SUPERNUMERARY KIDNEYS.—Extra kidneys are extremely rare. This condition is often confused with double kidney, which is quite different. Not more than 50 cases of extra kidney have been reported, and it is possible that not all of these have been authentic.
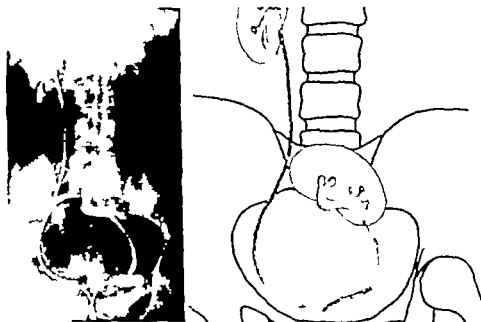
FIG. 45.—Pelvic ectopic kidney. This is quite different from kidney ptosis. Blood supply to this kidney was derived from the iliac vessels.

DOUBLE KIDNEYS.—Ordinarily each kidney has one pelvis and one ureter. In the case of double kidney there may be two pelves and two ureters (Fig. 46). These kidneys have considerable increase in total volume of kidney tissue although usually one of the pair of pelves is somewhat rudimentary. This is a fairly common anomaly. It occurs more frequently on one side. Bilateral reduplications, where both sides have double kidneys and complete double ureters, are not common.

UNILATERAL FUSED KIDNEYS.—Sometimes kidneys fail to ro-
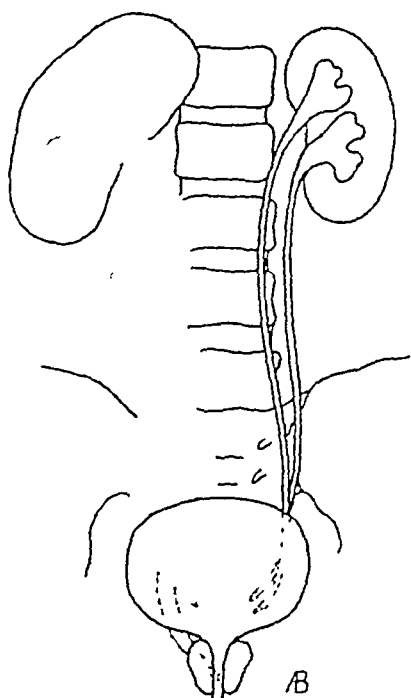
FIG 46 —Hydronephrosis in double kidney in boy, 14, long treated for pyelitis *Upper left*, hydronephrosis and hydro-ureter *Upper right*, course of ureters and ectopic implantation of upper one into prostatic urethra *Below*, surgical specimen

tate properly when they are formed from the embryonic structures and then fuse together In these cases, both kidneys are on the same side but fused. One ureter crosses the midline to get to its normal

FIG. 47—Unilateral fused kidney Ureter from lower kidney crosses over and is implanted in normal position for a right kidney Upper kidney is filled with a large branched or staghorn calculus. Ureter from upper kidney is implanted in the bladder in normal position for a left kidney and is blocked by two large stones. In man, 62, who is doing well after five years without treatment.

position in the bladder (Figs. 47 and 48) Such kidneys are forever giving trouble. They may take all manner of shapes and are called sigmoid kidney L shaped kidney or cake kidney These monstrosities may be ectopic or misplaced lying anywhere from a normal position in the kidney fossa to various positions in the flank and
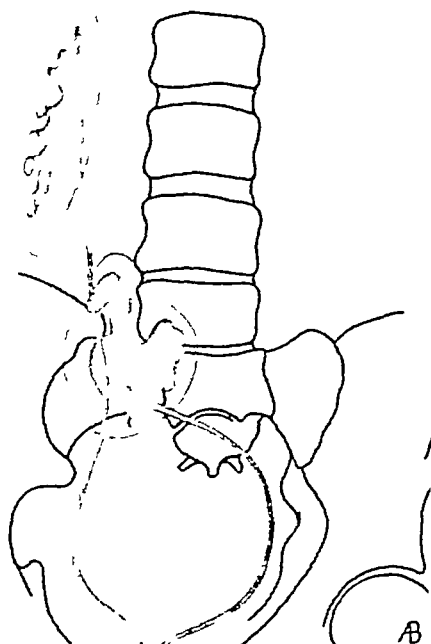
FIG 48—Unilateral fused kidney, an incidental finding, with no symptoms referable to kidney
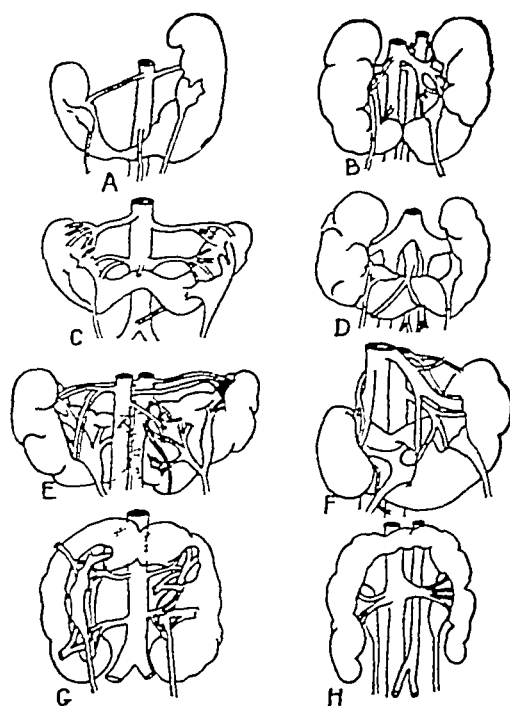
FIG 49—Various types of horseshoe kidney, as described by Scholl *et al*

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down into the true pelvis. Naturally such kidneys are prone to disease.

HORSESHOE KIDNEY.—This is probably the best known of the renal anomalies. Actually it is a fused kidney in which the kidney masses attempt to maintain their correct body position (Figs. 49 and 50). The common fusion spot is between the lower poles of

FIG. 50.—Horseshoe kidney with stone in each half of the kidney. *Left* pyelogram clearly portrays the anomaly. *Right* drawing of autopsy specimen.

the kidneys, forming what is called the isthmus. the narrow "neck" of kidney tissue which connects the two kidneys. Rarely the fusion is at the upper poles. The isthmus is generally in front of the great vessels, aorta and vena cava. Sometimes the isthmus is behind these large abdominal vessels. This is difficult to explain from an embryologic point of view. Horseshoe kidneys have many extra or aberrant renal arteries. The kidney pelvis, which normally comes out from behind the renal vessels, often is in front and the ureters pass over
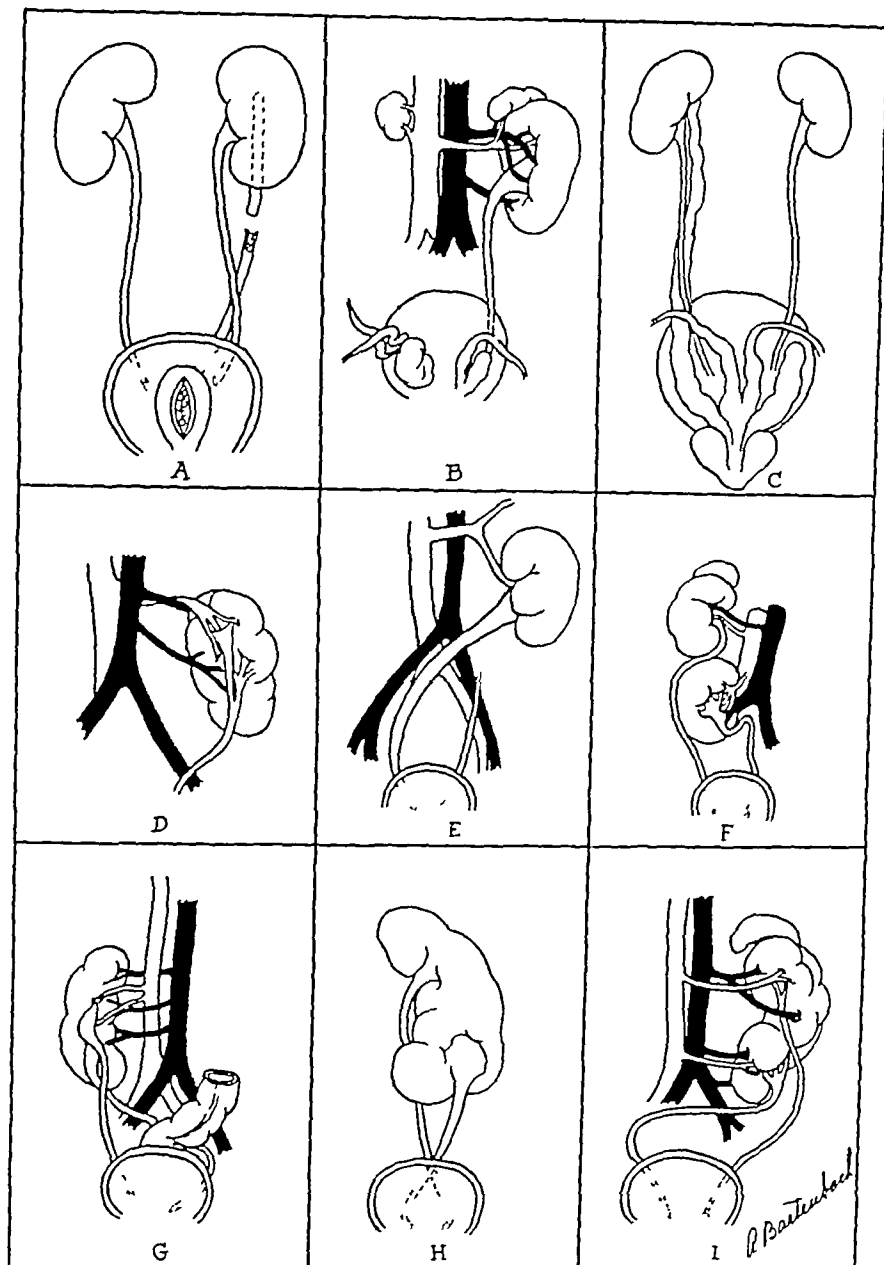
FIG 51 —Renal and ureteral anomalies *A*, double kidney with double ureter, one ending in ureterocele filled with stones *B*, solitary kidney with ureter in seminal vesicle on same side *C*, double kidney with double ureter, one in the seminal vesicle *D*, solitary kidney with faulty rotation *E*, solitary kidney with single ureter with crossed dystopia *F*, two kidneys on same side, not fused *G* and *H*, fused kidneys with ureters in normal position in bladder *I*, unilateral fused kidney resembling horseshoe kidney except that lower portion failed to rotate up into position

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the isthmus. Not uncommonly one or both halves of the horseshoe kidney have reduplication of the pelves and ureters

Many other minor anomalies of the form of the kidney and pelvis are only of academic interest.

Anomalies of the Ureter

It is scarcely possible to consider anomalies of the ureter apart from anomalies of the kidney (Fig. 51) However because of certain bizarre courses and implantations, they can better be dealt with separately

One of the commonest anomalies is in number Sometimes there are three, four or five ureters. When there are two ureters to one kidney the ureter from the superior renal pelvis almost invariably has the lower implantation in the bladder trigon. Sometimes one ureter is absent completely Sometimes the ureter on one side is incomplete, ending blindly with no kidney on that side.

Anomalies of Origin and Implantation

The ureter and the kidney pelvis are one when considered embryologically The kidney parenchyma is formed separately and joins the pelvis at an early date. The ureters grow upward from the ureteral bud to the wolffian body and are transferred early to the urogenital sinus, which later becomes the urinary bladder

The most important consideration is the so-called faulty implantation of the ureter Under this heading comes the extra or supernumerary ureter which is ectopic or misplaced. It has been described as being implanted in the female urethra, the prostatic urethra, vagina, cervix, uterus and outside, beside the urethra on the vulva. Cases of the ureter from a solitary kidney opening into the seminal vesicle are on record. Sometimes, as in one of our cases, the single ureter opens on the posterior part of the bladder above and away from the trigon.

Congenital diverticula of the ureter are extremely rare. Certain congenital dilatations are thought to be anomalous but there is still controversy over their origin (Fig. 52)

Congenital kinks, twists or strictures and valves may be associated, they are generally found in childhood Congenital strictures and valves are the most common and most important They account for many urinary disorders of childhood

Interest in one other rare anomaly of the ureter has recently been revived by reason of discovery of new cases That is the postcaval
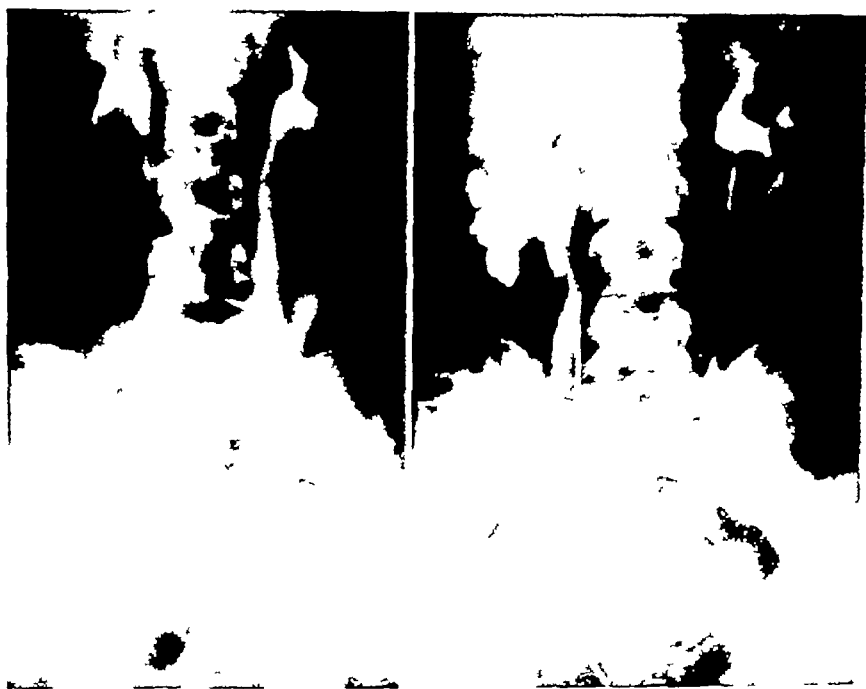
FIG 52—*Left* congenital dilatation of lower end of left ureter, no obstruction at vesical end Four no 6 ureteral catheters could be inserted together *Right,* congenital dilatation of ureter with hydronephrosis in woman, 45, with no symptoms until kidney became infected

ureter This bizarre type consists of a ureter which passes around behind the vena cava Its extreme rarity adds to its interest

Anomalies of the Urinary Bladder

EXSTROPHY —The commonest and perhaps one of the most important anomalies of the bladder is exstrophy or ectopia vesicae (Figs 53 to 55) In this anomaly the urinary bladder has no anterior wall and lies everted and exteriorized on the lower part of the
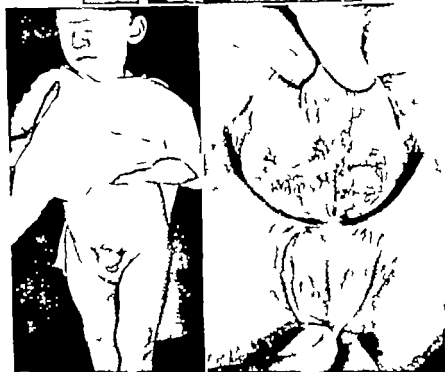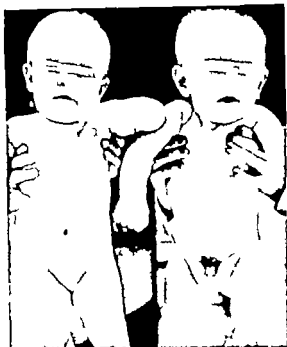
FIG. 53.—Exstrophy of bladder *Above* in the male of twins. *Below left* in boy 4 *Below right* close-up of bladder and penis.

abdomen The patient has no umbilicus The symphysis pubis is separated widely The two rectus muscles, which are ordinarily in one sheath side by side in close apposition, are attached separately to the two ends of the gaping symphysis, forming a triangle The space between is occupied by the ectopic bladder and has only a thin wall of fascia between the posterior bladder wall and the
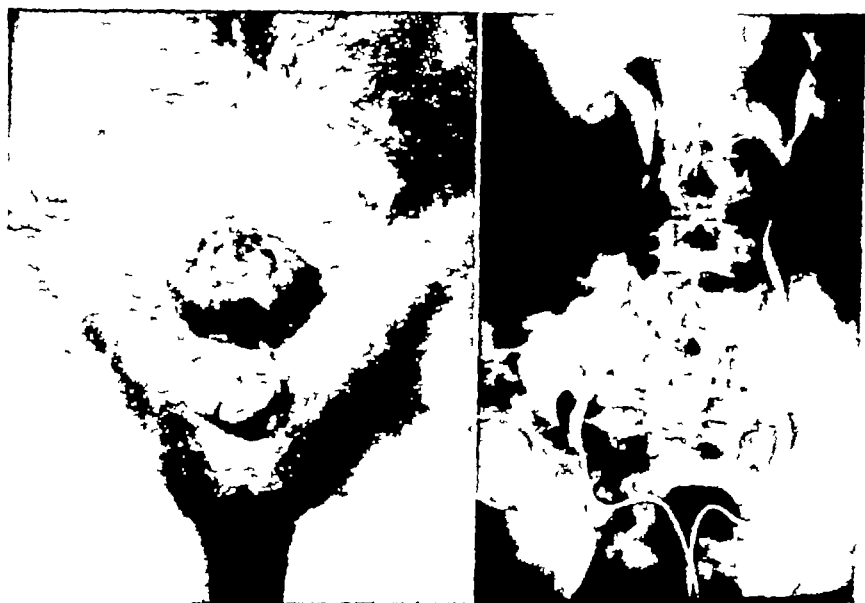
FIG 54 —Exstrophy of bladder with complete epispadias in man, 42 *Left* the bladder *Right* pyelogram showing that despite years of exposure to infection, ureters and kidneys are remarkably near to normal, note wide separation of symphysis pubis

peritoneum The ureters usually open in the normal position on the trigon, and urine drips out freely and rhythmically down the front of the body The urethra is usually completely open, with complete epispadias (see p 184)

There are numerous variations of these defects of the bladder In some, the bladder is not completely exstrophic There are many accompanying congenital defects, such as undescended testes, misplaced penis, spina bifida, harelip and clubfoot (The treatment is described in Chapter 13)

Exstrophic bladder

Right ureteral orifice   Left ureteral orifice

Excoriations   Scrotum

Anus   Penis

d. Bachulech
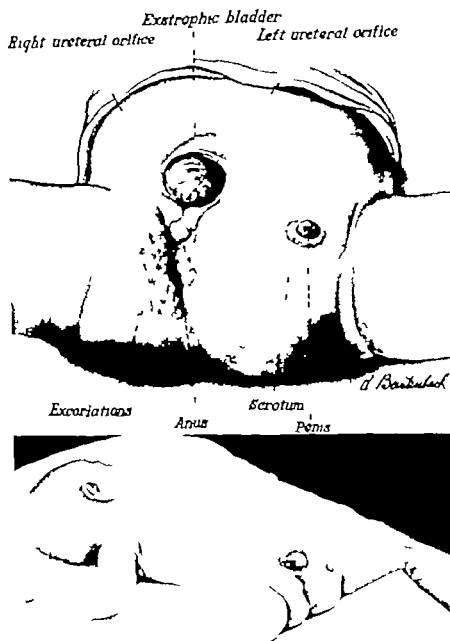
FIG. 55—Unique case of exstrophy of bladder. Two ureters open into the bladder: the penis is misplaced, urine passes from the ureters in rhythmic drops, and a stream of urine passes from the penis.

far the most common The urethra ends almost imperceptibly
the skin just back of the frenum It is short in all degrees of hy
spadias In addition there is a bending down and back (chord
of the glans and the whole penile shaft Commonly there are
dundancy of the foreskin and hooding of the glans penis. In
first type, or glandular hypospadias, operation is generally not c
sidered necessary In the other three, proper operative procedu
are advisable for correction and cure In the penoscrotal and perin
types, the man may be sterile because the semen cannot enter
vagina during copulation

Epispadias is a rare anomaly which is primarily a male defe
It occurs in the female in cases of exstrophy of the bladder 1
defect consists in failure of the urethra to close There are th
degrees the glandular or balanitic type, in which the glans pe
is split and the urethra is spread out like a gutter, the penile ty
in which the urethra ends nearer the symphysis, but anywhere alo
the dorsum of the penis, and the complete type, in which the who
urethra is open on the dorsum of the penis, the two corpo
cavernosa being widely separated In the complete form there
no sphincter to the bladder and it almost always accompan
exstrophy of the bladder of whatever degree

Scrotum and Testes

The scrotum may be cleft, that is, divided into two separa
pouches It may also be apparently absent In the case of bilater
undescended testes, the scrotum appears to be completely abser
The tissues that make up the scrotal sac are so versatile that the
can form an enormous sac out of apparently very little tissue in
short time

TESTES —There are only two types of anomalies of the testes, an
they are anomalies in number and in position Anomalies in num
ber are less important because they are rare Absence of the teste
or anorchism, is exceedingly rare and is generally found at autops
on infants who have numerous other anomalies

Lack of development of the testis has also been classed as an anomaly but, in the strict sense, may not be congenital. Other forces may have influenced or impeded its growth and development. In undescended testes, development may be interfered with because of malposition.

Fusion of the two testes has been reported. Supernumerary testes are also rare, but some 15 proved cases have been reported.

Anomalies of Position —By far the most important anomaly from the practical and clinical standpoint is that of position, generally

FIG. 57 —Hermaphrodite or pseudohermaphrodite, with penis and testes as well as vagina. Presence of ovaries was not determined, but true hermaphroditism is rare.

called undescended testis. At the sixth month in the male fetus the testes are at the internal inguinal ring. They do not arrive in their final normal position in the scrotum until just before birth. There are numerous instances of the testes completing their descent during the first month or two after birth.

It was formerly thought and taught that the gubernaculum pulled the testes down the canal and into normal position in the scrotum. The gubernaculum develops along with the testis and is derived from a fold of peritoneum. It is a connective tissue cord. Because of presence of smooth muscle fiber in it, its influence was thought

to be considerable in causing the descent of the testicle Anatomists have shown that the gubernaculum has six points of attachment (1) to Poupart's ligament, (2) to the pubic bone, (3) to Scarpa's triangle, (4) to the ischium and perineal fascia, (5) to the base of the penis, and (6) to the bottom of the scrotal sac Therefore, the testis has at least seven ways in which it may be aberrant It may remain in the abdomen and never enter the inguinal canal or start its descent This is called cryptorchism If it enters the inguinal canal, it may stop anywhere in the canal short of its proper position—called undescended testis Here it follows that branch of the gubernaculum which would lead it to normal position in the bottom of the scrotum

The testis may follow any one of the five fasciculi, and thus we have the explanation of the aberrant or faulty descent The testis may be found near Poupart's ligament, in front of the symphysis or along the pubic bones, in Scarpa's triangle, in the ischial region in the perineum or in the base of the penis

In Chapter 16 we discuss the clinical application of undescended testis and the medical and surgical procedures for a cure

Reference is made in various other chapters to the anomalies pointed out here Fuller discussion of their significance as causative factors in disease appears in the chapter devoted to that particular organ or subject

Urinary Lithiasis

PROBABLY NO disease has been more accurately described from ancient times than urinary calcareous disease. The disease has changed as the habits and customs of the people have been altered. In parts of India and China, the stone problem remains the same as it was for hundreds of years. In this country better physicians and better diagnostic methods have made early recognition the rule so that in general the urinary calculi are smaller when discovered than formerly

Certain once common types, as bladder stones in children, have almost completely disappeared. A little over a hundred years ago study of the chemical composition of the urine was begun, and soon after that, the study of the chemistry of urinary calculi. From these studies a better understanding of the formation of urinary calculi was obtained. We shall consider each division of the problem, in cluding symptoms, diagnosis and treatment, in the following manner

    I. Renal calculi

    II. Ureteral calculi

    III. Bladder calculi

    IV Urethral calculi

    V Etiology of urinary calculi—(a) theories of stone formation

        (b) description of various types of stone

    VI Sulfonamide deposits in the urinary tract

    VII Prophylaxis against recurrence

I *Renal Calculi*

SYMPTOMS —*Pain* —This is the most constant symptom of renal stone It is often intermittent, varying in severity and intensity Unfortunately it is not characteristic A stone in a fixed position in the kidney and not obstructing the flow of urine may cause a steady, dull aching pain, felt most commonly directly over that part of the upper abdomen overlying the surface of the kidney involved The stone may cause violent colicky pains which are most intense in the upper abdominal quadrant corresponding to the location of the affected kidney The pain radiates down on the abdomen over the crest of the ilium and to the genitalia and may radiate down the inner aspect of the thigh to the sole of the foot or the heel

True renal colic is accompanied by many reflex symptoms Vomiting and nausea are often present and may become dangerous because of the violence of the body-racking paroxysms Accompanying the nausea and vomiting may be profuse perspiration The patient is often pale, almost greenish, and covered with a cold clammy sweat He fears to move, for the slightest motion seems to start a new and more violent paroxysm The abdomen may be rigid on the affected side Sometimes the rigidity extends over the whole of the abdomen. There is often distention of the abdomen largely due to the reflex effect on the nervous mechanism of the intestines There may be mild to severe cyanosis from straining Occasionally reflex pain arises which is referred to the stone-free kidney Occurring along with the boardlike rigidity of the abdominal muscles is a painful reflex, spasmodic contracture of the dartos and cremaster muscles, pulling the scrotum and testes close to the body. When the paroxysm passes and the abdomen relaxes, the abdomen becomes soft and pliable and the scrotum and cremaster muscle relax.

The onset of the colic may follow lifting We have seen many such cases The stone suddenly becomes dislodged by effort and finds a new and painful position within the kidney Often the attack

awakens the patient in the night. A common time for an attack to begin is in the early morning on arising

So far we have described only the pain caused by the stone itself. When the stone moves into a position where it obstructs the flow of urine and urine begins to be accumulated in the kidney pelvis, certain variation in the symptoms takes place The sharp colic disappears and in its place there is a dull steady throbbing ache. The patient describes it as a feeling of pressure as if something were about to burst. The pain distribution changes somewhat with this accumulation of urine. The stretching of the kidney pelvis first produces pain, and following this the stretching of the renal capsule causes the pain to be intensified. This pain is referred to an area 10 cm. in diameter of which the costovertebral angle is the center If the patient is not relieved, the pain may last for many days. The kidney pelvis and capsule, as well as the whole parenchyma, slowly stretch to large size until the nerve endings are ultimately paralyzed and the patient no longer suffers pain.

Blood in the Urine—Hematuria varies from a massive hemorrhage from the urinary tract to a few blood cells found only by microscopic examination. Both these manifestations are of diagnostic importance. Absence of blood in the urine does not exclude stone nor does presence of blood in the urine, without other signs and symptoms, warrant the diagnosis of stone in the kidney Blood in the urine occurs in about 40 per cent of the cases. Renal calculi more often produce gross bleeding and consequent marked hematuria than stones in any other location in the urinary tract.

Pyuria.—In uninfected cases, clear urine, free from even microscopic pus is the rule The amount of pus in the urine may vary considerably Certain bacteria, like colon bacilli, lend an opalescence to a slightly hazy urine In advanced renal calculosis in which there are numerous stones and marked infection, the urine generally has a characteristic appearance and odor When freshly voided, it is pale and loaded with pus. There are, in addition, long strings of ropy mucus-like substance If the urine is allowed to stand for

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mesentery and closely approximate true stone shadows Phleboliths, or calcifications within a vein, cast dense round shadows that cannot easily be distinguished from true urinary stone on the film Old blood clots from an injury to the kidney may, on healing, calcify and produce confusing shadows Gallstones are frequently large and dense enough to be confused with true renal calculi

More valuable, indeed, than this series of negative observations
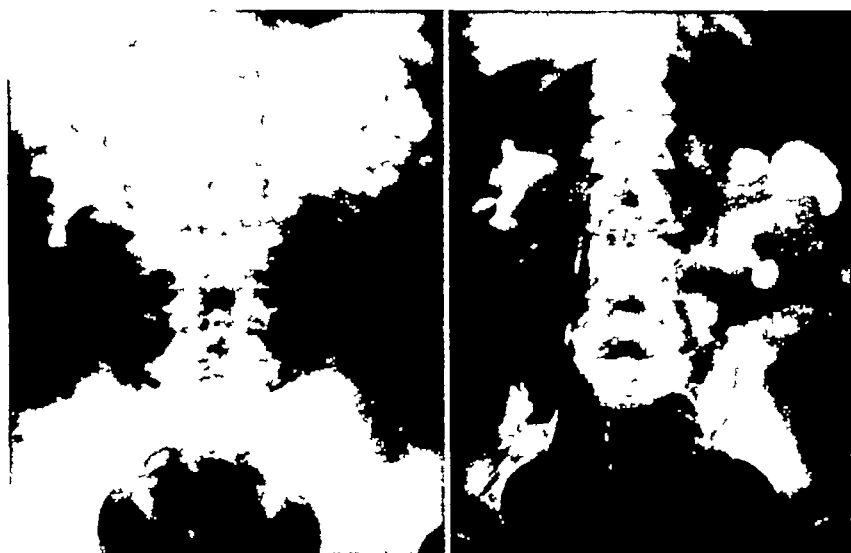
FIG 58 —*Left,* bilateral massive renal calculi (malignant stone disease) in man, 27 Cause is not clear *Right,* bilateral renal calculi in woman, 53, with parathyroid disease, evidently the cause of the calculosis

are those on the positive side A plain or scout film may show some surprises, such as the finding that both kidneys are filled with stones when only one was suspected of harboring a stone The number, shape and size of the calculi can be seen in shadow As on one occasion, we suspected stone in the bladder but found not only a large stone in the bladder but a stone in each kidney Incidentally, there may be stones in the ureter as well as a stone in the kidney We have seen a horseshoe kidney clearly and unmistakably outlined on the roentgen film because of multiple small diffuse calculi which rendered it opaque

FIG. 59—*Above* calculous pyonephrosis in woman, 42 treated for pyelitis because of pus in urine. Pyelogram showed large calculus in right kidney: excision showed the kidney a mass of fat and scar tissue. *Lower left* renal calculus projecting down into ureter of kidney with an aberrant artery to the lower pole: *center* stone removed at operation, with string in groove formed by pressure of the aberrant vessel. *Lower right* large stone in left kidney pelvis of girl, 3 treated for pyelitis. Stone was removed by pyelotomy and she has had no recurrence after 12 years.

The special urologic examination is next in order Some surgeons tend to omit a cystoscopic examination and substitute intravenous urography This may lead to gross errors in diagnosis Cystoscopy with catheterization of the ureters provides more information than can be obtained in any other way Catheterization of the ureters makes possible the study of urine from each kidney The function of each kidney can be estimated by using either indigo carmine or

FIG 60 —*Left,* large silent stone in right kidney, which is almost completely destroyed. *Right,* kidney with the stone in situ.

phenolsulfonephthalein. Stereoroentgenograms can then be made with radiopaque catheters in the ureters This is important, since all opaque shadows not in the plane with the catheter can be considered not in the urinary tract.

The kidneys are tested for hydronephrosis by aspirating through the ureteral catheters with a syringe Next an opaque fluid, such as skiodan, is instilled and stereoroentgenograms are made With these films the stone can usually be accurately located and its exact size determined (Figs 59 and 60). On the basis of these studies the probability of just what may happen can be anticipated. If the

stone is small enough to pass, the patient can be assured that operation is not contemplated. If the stone is too large to pass, that fact is also important to the patient.

TREATMENT OF RENAL CALCULOSIS.—The treatment of renal stone may well begin with the management of the pain of an acute attack of renal colic. It is to be emphasized that the severity of the pain bears no relation to the size of the stone. Small stones may cause excruciating pain while large stones may be completely silent—the reverse is also true.

The attack of severe renal colic is an important emergency to the patient and his family and the doctor generally receives an urgent call. History symptoms and signs similar to those just enumerated will permit the doctor to decide he is not dealing with some acute intra-abdominal lesion. The patient now needs immediate attention.

The opiates offer the quickest relief from pain. Morphine in doses of ¼ gr by hypodermic is indicated. To this may be added 1/100 gr of atropine. It is well known that morphine stimulates the un striped muscle of the kidney pelvis and ureter and increases its tone, so until the sedation affects the higher centers the pain may be in creased. Atropine or hyoscine given with the morphine neutralizes this early stimulating effect, and quicker relief from the colic is obtained. Pantopon in 1/3 gr doses is an excellent drug and is preferred by some. There are times when the colic is so severe that even morphine in ½ gr doses does not relieve the pain and the physician hesitates to continue the drug because of its depressing effect on respiration and the circulatory system. Demerol may be safely used in doses of 50 to 150 mg. given hypodermically or by mouth.

We have resorted to the use of pentothal sodium (Abbott) in travenously on these occasions. The fact that the patient may have had morphine preceding pentothal sodium is not strictly a contra indication. Twenty cubic centimeters of a 2½ per cent solution of pentothal sodium is prepared and drawn up into a sterile 20 cc. syringe. The arm is strapped to a board and venipuncture is done in the usual manner. The patient is told to count aloud, one, two,

three, etc The administration is then begun very slowly Usually the patient stops counting before he reaches 20 As soon as he drops off to sleep administration of the pentothal sodium is discontinued and the reflexes are tested. The jaw drops down and must be supported so that breathing is not interfered with One or two additional cubic centimeters of pentothal sodium should be given very slowly then the needle withdrawn. In all, not over 10 cc (of a $2\frac{1}{2}$ per cent solution) need be given.

The patient will sleep quietly for one to three hours following this and even the severest colic will be relieved and generally will not return the instant the patient awakens There are exceptions to this statement. In case the stone is obstructing the outlet to the kidney pelvis and the pain is due to the pressure of urine in the kidney pelvis, the pain will return as soon as the anesthesia induced by the pentothal sodium wears off

The pain having been relieved, there may be a long interval of complete quiescence, during which the patient is unwilling to be put to any trouble to find out the real cause of his colic After a second attack the patient is usually willing to co-operate with his doctor in establishing the diagnosis The patient should then be brought to a hospital where roentgen studies can be made If the patient has had opiates, as is nearly always the case, the gastro-intestinal tract will be so full of feces and gas that the K.U.B tract will be completely masked out. If the scout plate shows this condition, a cathartic of 1-$1\frac{1}{2}$ oz. of castor oil should be given, followed by a cleansing enema The repeat films will then portray the tract more clearly If these plates reveal no opacities that can be classed as urinary calculi anywhere along the urinary tract, it must be recalled that the incidence of nonopaque or nonvisualizable urinary concretions is 10-12 per cent or more

If the clinical picture was that of renal colic, one need not be afraid to stick to the diagnosis of renal or ureteral stone, for even a tiny sharp uric acid crystal will cause violent colic If there is reasonable assurance that the stone is small, the patient can be told

that it will pass. With the idea of obtaining proof the patient should
be instructed to look for a tiny crystal perhaps as small as a seg
ment of a pin and sometimes only 2 or 3 mm long He should
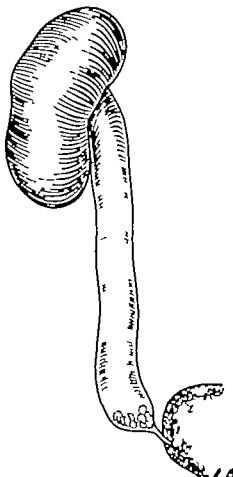
FIG. 61—kidney and ureter the seat of pyonephrosis and pyo-ureter due to
several stones impacted against the bladder in the right ureter of a man 70
When 19 he had ureteral colic but passed no stones. The stones were probably
in the ureter over 50 years. *Left* stones in the ureter against the bladder
Right extent of damage to the kidney

pass his urine through gauze so that the calculus can be caught.

The treatment of stones in the kidney that are too large to pass
is surgical Most stones in the kidney can be removed by incision
through the pelvis. No damage is done to the kidney A nephrotomy
is sometimes necessary but is not to be approached lightly

II *Ureteral Calculi*

SYMPTOMS —For convenience in discussing the distribution of pain arising from ureteral calculi, the ureter may be divided into three segments or divisions—the upper, middle and lower thirds Each segment is about 4 in long

The pain arising from a stone impacted in the upper third of the ureter may not always be distinguishable from that produced by a stone in the kidney The character of the pain of ureteral colic is the same as that of renal colic Distribution of the pain varies somewhat as the stone moves down through the ureter The pain arises from two causes (1) the ureter is traumatized as it clamps down on the sharp spiculed calculus and pain reflex is set up, and (2) the calculus blocks the ureter and dams up the urine above the stone, causing pain from distention of the ureter and kidney pelvis

If the patient has had a previous attack he recognizes his old enemy when a second attack occurs and will make his own diagnosis correctly (For further details on ureteral pain distribution, see Chapter 12)

As long as the calculus remains in the upper third of the ureter, pain may be the only symptom There are exceptions to this, we have seen cases in which a stone impacted in the upper third pro duced marked bladder symptoms such as frequency, burning and tenesmus As soon as the stone moves into the middle segment of the ureter, the percentage of accompanying bladder symptoms increases With stone in the lower third of the ureter, pain may be the predominating symptom, but bladder symptoms will also be prominent, including burning and difficulty on urination, frequency, nocturia, tenesmus, dribbling and incontinence of urine

Blood in the urine is generally microscopic, but not infrequently gross hematuria occurs Pus appears in the urine in infected cases

DIAGNOSIS —The diagnosis of ureteral stone is not always simple The symptoms, however, generally point clearly to the correct diagnosis Here, as in renal colic, the size of the stone bears no relation to the severity of the pain

It has been generally estimated that 3 5 per cent of ureteral calculi cast no shadows on the roentgenogram. This is, however according to our experience far too conservative an estimate. Fully 12 15 per cent of ureteral stones are invisible to the roentgenogram or at least are not dense enough to cast shadows on the film

FIG. 62—Appendical concretion simulating ureteral calculus. A ureteral catheter was passed and a double exposure made shifting the roentgen tube. The shadow of the concretion moves away from the catheter proving that it is not in the ureter

It follows, therefore, that with a good history and typical ureteral colic, a negative roentgen report does not completely rule out ureteral calculus. Much care must be exercised in taking a K.U.B plate in order to have the whole length of the ureter from the kidney to the bladder portrayed on the film We have seen many films in which about 1 in. of the lower end of the ureter was not shown. It was in this missing 1 in. that the stone was invariably located.

Also, it is important to scrutinize carefully the areas of the ureter which overlie the dense bony pelvis Stone shadows may easily fuse with the bony background and therefore be missed When there is the slightest doubt, catheters should be inserted in the ureters and roentgen studies made (Fig 62) These films should be made either in stereo or by shifting the tube and making a double exposure When differentiation must be made from calcified glands, an oblique or lateral angle should be used. This throws the opacity away from the ureteral catheter if it is not within the ureter itself In the lower third of the ureter, calcifications in the pelvic veins, known as pheboliths, are common sources of error More than 50 varieties of extra-ureteral, false stone shadows have been enumerated by different observers

On the right side. differential diagnosis of appendicitis and ureteral calculus is extremely important If error is to be made, it would be better to remove a normal appendix than to miss an acute, fulminating, dangerous one

DIFFERENTIAL DIAGNOSIS OF URETERAL STONE AND ACUTE APPENDICITIS

	RIGHT URETERAL STONE	ACUTE APPENDICITIS
Age	Rare under 20	Any age
Sex	Slightly more common in males	No difference
Pain	Sharp, lancinating, severe, paroxysmal	Steady dull aching; sometimes sharp
Pain distribution	Radiates to genitalia, down inner aspect of thigh and leg to heel or sole, to an area on outer aspect of the hip	May first be in epigastrium or on the opposite side low on the left, but shifts as disease advances and becomes centered over McBurney's point
Tenderness	To inside and below McBurney s point, seldom marked	Tenderness over McBurney's point
Chills	May be chill but usually not unless ureter is obstructed and urine is under pressure and infected	Onset may be with a chill or chilly sensation

DIFFERENTIAL DIAGNOSIS OF URETERAL STONE AND ACUTE APPENDICITIS
(Cont)

	RIGHT URETERAL STONE	ACUTE APPENDICITIS
Fever	Temperature generally normal or subnormal cold and clammy covered with sweat; pale to greenish	Temperature 99.4 101 F common seldom higher flushed and dry
Gastro-intestinal disturbances	Often retching and nausea sometimes vomiting; may be distention of abdomen during acute attack which relaxes as soon as attack is over	Vomiting sometimes marked feature but sometimes absent nausea often present constipation usual
Rigidity of abdomen	Occurs during attack and relaxes when paroxysm passes or is relieved by opiates	Occurs in right side not board-like but perceptible
Leukocytosis	Count usually normal 5,000-9,000	Varies, but generally shows 11,000 cells early with tendency to increase as disease advances seldom over 16,000 sudden drop from 14,000 16,000 to 5,000-6,000 may indicate perforation or rupture into peritoneum
Mass	None	May be in right lower quadrant between anterior superior iliac spines and umbilicus
Urinary findings	Usually microscopic, sometimes gross blood	Usually no blood cells but when appendix is retrocecal and lies on ureter blood cells are present
Retention of urine	May occur when stone is within 1 or 2 in. of bladder due to reflex	May occur when appendix lies in pelvis and touches bladder or ureter
Frequency tenesmus strangury	May occur from retention	May occur for above reasons
Roentgen study	In 85 90% stone is shown appendical concretions must be carefully distinguished from ureteral stone shadows calculus in right ureter does not preclude possibility of coexisting appendicitis	Area clear except with perforation, when there is increased density with intestines pushed away from appendical area, calculus and appendicitis occur together about 1 1,000

TREATMENT — As in renal colic, ureteral colic demands attention because of severity of the pain All the means used to control the pain of renal colic are applicable here (p 195)

To predict how long it will take a given stone to traverse the 12 in of the ureter is sometimes impossible The size of the stone as shown on the roentgen film apparently has nothing to do with its ability to pass down the ureter and into the bladder We have seen 15 × 1 cm stones pass

In addition to opiates and pentothal sodium, other measures for relief from the colic are available Hot applications to the affected side are sometimes soothing Immersing the patient in a bathtub of hot water (temperature 105 F) is relaxing and comforting

Where there is actual cessation of urinary output something must be done at once to relieve the situation So-called calculous anuria may occur when the ureter is completely blocked by the stone and there is only one kidney, the other having been previously removed surgically. In such cases attempt must be made to get a ureteral catheter past the stone and into the kidney pelvis Such a catheter, once in place in the ureter, should be left in situ for drainage Presence of the indwelling ureteral catheter also sometimes loosens the stone and aids in its passing Most ureteral stones are finally passed.

There are two methods of dealing with stones that are retained, and both are surgical A stone that makes no progress for three or four weeks should be removed surgically. When the stone is in the lower third of the ureter and close to the bladder, that is, within 2 in., cystoscopic manipulation may be tried, using any or all of the various baskets and ureteral stone dislodgers Successful removal of a stone by this method requires an uncanny degree of skill and the attempt is not to be approached lightly Open surgery is preferable in many cases The approach is extraperitoneal The incision is carried down to the peritoneum, then the peritoneum is followed around to the space where the ureter is found. In the approach to the lower third of the ureter, a suprapubic midline incision is made

exactly as if a bladder operation were to be done. The bladder is filled. The incision is made in the midline and carried down to the bladder The peritoneal reflection is pushed up and the dissection carried around the side of the bladder until the ureter is found. The bladder is then allowed to drain empty After the stone is removed by incising the ureter one to three triple 0 chromic catgut interrupted sutures are used to close the incision in the ureter care being taken to see that the needle does not include the mucosa of the ureter A small piece of catgut exposed in the ureter might become the nucleus for another stone.

III Bladder Calculi

SYMPTOMS.—Stones in the bladder unaccompanied by infection may produce symptoms so slight as to be totally unnoticed by the patient. Stones that are rough or have sharp spicules may cause mechanical irritation and pain. As in the case of stone in the kidney and ureter pain may be the principal feature. The patient may complain that riding in an automobile or other vehicle, particularly farm apparatus such as a plow cultivator or reaper causes marked bladder discomfort and sometimes pain. We have had patients tell us they felt the stone roll around in the bladder on change of body position. Another symptom, described as diagnostic in all the texts, is the sudden stoppage of the urinary stream caused by the stone rolling down over the internal urethral orifice. We have seen several instances of this, but it is not nearly as common as is generally supposed. The remaining symptoms are those of cystitis. (See Chapter 13 for a full discussion.)

DIAGNOSIS.—The discovery of stones in the bladder may be made in three ways

1 By use of the time honored stone searcher which is nothing more than a probe-pointed small sound. A small metal sound will do perfectly The instrument is passed gently down the urethra into the bladder The click and grating sensation transmitted to the fingers through the metal instrument establish the diagnosis of bladder stone.

2 Visualization of the stone by means of the cystoscope

3 Visualization of the stone by roentgen studies

TREATMENT —The treatment of vesical calculi is surgical

Litholapaxy, or the operation of crushing the stone with an instrument called a lithotrite, and washing out the fragments is in skilful hands the procedure of choice for all but the largest stones Stones up to 1 in in diameter can be crushed and disposed of in this manner. Unless the operator has had special training or wide experience with litholapaxy, it had best not be attempted

Suprapubic opening of the bladder is far safer in the hands of the average surgeon The usual midline incision is made, the bladder opened and the stone removed. Not to exceed 3 Gm of sulfathiazole in finely divided crystalline form is sprinkled in the wound, particularly in the prevesical space, and the wound closed in layers around a small (20 F) Malecot catheter which is left in the bladder for drainage No drain need be placed in the prevesical space when sulfathiazole crystals are used in the wound

IV Urethral Calculi

There are two sources of urethral calculi· stones that become impacted in the urethra (Fig 63), and prostatic calculi that are extruded or erode into the urethra Ordinarily stones of considerable size can be passed through the male urethra, although this is a painful ordeal. When a stricture of the urethra is present, even a small stone lodged behind it will remain there and gradually increase in size Stones have been known to pass out of the urethra and into the prepuce and, because of a pinhole phimosis, remain and grow in the space between the glans penis and foreskin

Large dumb-bell-shaped or hourglass stones have been removed from the prostatic urethra, having been molded to these characteristic shapes Generally these stones are grooved so that the urine can pass, even though the stream is reduced to a trickle When impaction is complete and the flow of urine is completely blocked, serious results follow quickly Extravasation of urine usually takes place Abscess appears around the stone Necrosis of the urethra

due to a combination of pressure and infection is sometimes rapidly fatal.

TREATMENT—A stone in the urethra should be removed as quickly and carefully as possible For stone in the deep urethra, incision of the bladder suprapubically may be required. For stones
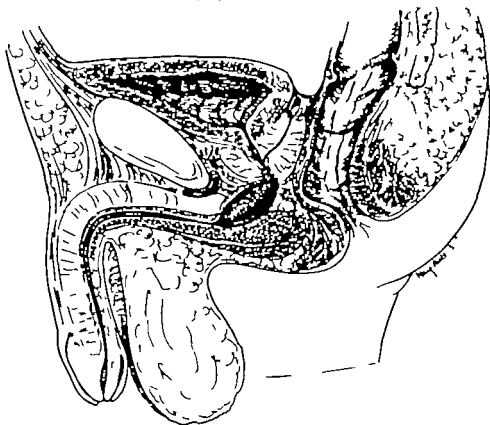
FIG. 63 —Calculus impacted in the membranous portion of the urethra.

in the pendulous urethra, removal may be accomplished by forceps. Incision of the urethra is preferable, for in the event of trauma to the urethra strictures will surely follow

V *Etiology of Urinary Calculi*

THEORIES OF FORMATION —The various theories of etiology will be discussed in the following order

1 Hereditary predisposition
2. Inadequate water intake

3   Vitamin A deficiency

4   Urinary stasis

5   Disturbances of urinary colloid and surface tension

6   Infection

7   Influence of diet

8   Metabolic disturbances (glandular or parathyroid disease)

9   Recumbency

10   Randall's hypothesis

11.   Geography, climate and race

12   Age and sex

1   *Hereditary Predisposition* —There is a tendency to minimize hereditary influences as they relate to certain pathologic conditions. In stone formation, heredity may play an important part, particularly in what may be termed malignant stone disease By this we mean that while it is not a familial or inherited disease, the tendency is there On several occasions we have observed renal stone disease in various members of the same family This may, of course, result from closely copied family habits as to diet, water intake and general mode of living

2   *Inadequate Water Intake* —This may be a temporary condition forced on soldeirs or sailors by the exigencies of war On the other hand, many persons habitually restrict their water intake to a point below safety A chronically concentrated urine is an invitation to stone formation

3   *Vitamin A Deficiency* —Much has been done experimentally to prove that the vitamin deficiencies have an important bearing on urinary stone formation All of the work has been done on animals particularly dogs, rats and guinea-pigs The experimental work on rats has been quite convincing In rats deprived of vitamin A, phosphatic calculi rapidly form in the urinary tracts The attempt to correlate this with human stone formation is not so convincing In general, in areas where people consume, as a part of their regular diet, milk, butter, cheese, eggs, fresh meats and salt water fish, urinary calculi are rare Such a diet, of course, is rich in vitamin A.
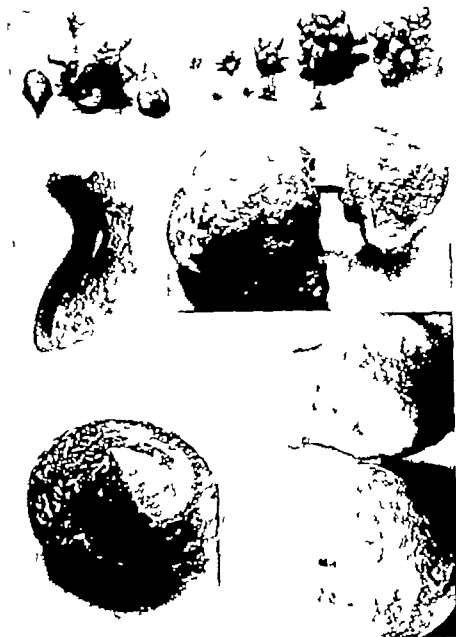
FIG. 64—Urinary calculi. *Top left* a single jackstone and two smaller stones
that evidently helped shape the large one. *Top right* nine jackstones found in
a bladder causing great pain. *Center left* stone molded to the posterior urethra
the blunted, headlike portion remained in the bladder *Center right* so-called
dumb-bell stone; the smaller end was in a diverticulum, connected to the larger
end in the bladder by a narrow neck. *Bottom left* hard oxalate bladder stone
with rough exterior concentric layers are seen. *Bottom right* exceedingly large,
soft white phosphatic calculi, molded together by friction in the bladder

4 *Urinary Stasis*—This implies a slow-chronic process. Acute retention that is relieved in a short time does not constitute stasis. Stasis may occur anywhere along the urinary tract. As soon as the urine becomes chronically impounded behind an obstruction, chemical decomposition takes place and various urinary salts are liberated. If a nucleus or a tiny foreign body is present, stone formation may begin at once.

5 *Disturbances of Urinary Colloid and Surface Tension*—The urine is a colloid. For this reason it can hold in solution a larger amount of salts than the same volume of distilled water and is a strongly supersaturated solution. This colloid can be broken up by bacterial action or pathologic changes in the renal secreting apparatus. When urine becomes stagnant, as in chronic stasis, the colloid tends to be broken up. In this process the normally finely divided colloid particles tend to coalesce, and thus the total surface area is diminished. This change in surface tension permits the urinary salts to fall out of solution.

6 *Infection*—Infection present in the kidney sometimes operates to form stones right in the kidney. On the other hand, infections at distant places in the body, such as osteomyelitis, sometimes cause stone formation, and infections in teeth and tonsils may have a bearing. Gallbladder and liver diseases are thought by some to influence the formation of urinary calculi.

7. *Influence of Diet*—During the Middle Ages urinary stone was a common disease. We know that scientific knowledge of diet was unheard of. There were two classes of people—the gluttonous and the starving. Both of these classes suffered equally from urinary stone disease.

Bladder stone was a common disease among children until 50 years ago, when medical science began to make progress in the proper feeding of infants and children. Improper diet, whether deficient in certain essential elements or vitamins or in amounts of caloric intake, can definitely influence urinary stone formation. Some persons habitually eat too much, and some eat far too little. When

a person on a properly balanced diet develops a kidney stone it is evident that some cause other than faulty diet is operating

8 *Metabolic Disturbances*—Parathyroid disease in the form of hyperparathyroidism has been cited as a factor in urinary stone formation, and so it is. The parathyroid glands govern calcium metabolism. When diseased, they allow the bones to be depleted of their lime salts. The salts thus liberated pass through the blood and out through the kidneys with the urine This is a definite, but rather uncommon, cause of renal stone formation. This eventuality should always be kept in mind of course when one is caring for a patient with hyperparathyroidism.

9 *Recumbency*—Orthopedic surgeons have long recognized that urinary stones can form in patients subjected to long periods of complete immobilization. These patients excrete an excess of calcium in the urine owing to depletion of the bone calcium Patients who have infantile paralysis of such severity that they have to be in an iron lung are also apt to form urinary stones. We have seen two such cases

10 *Randall's Hypothesis*—After a great deal of clinical observation and study of autopsy material Randall formulated a hypothesis of renal stone formation. He postulated that *(a)* a renal calculus in the absence of obstruction would of necessity require an initiating lesion in order to grow *(b)* such a lesion would have to occur on a renal papilla.

Search of pathologic material to find the possible initiating lesion (presumably an infection) failed to reveal any evidence, but a new pathologic condition was found, consisting of deposits of calcium in the walls of renal papillae. Microscopic sections of these deposits proved them to be subepithelial and extratubular Later from the urine further salts were deposited on the calcium plaque. It lost its epithelial covering as it grew and suddenly let go from the tiny ulcerative base on which it was formed and became free in the urinary stream Certainly this is a sound piece of work and explains many primary renal calculi.

11 *Geography, Climate and Race*—It is well known that in certain geographic areas bladder stone is common These are India, parts of China, Thailand, the Balkan Peninsula, the valley of the Volga, Arabia and Mesopotamia The disease is rare in South America and Africa The Negroes of the United States are more subject to urinary stone than their primitive brothers, but the disease is not common among American Negroes

12 *Age and Sex*—Renal stones may form at any age, but are quite uncommon in persons under 20 Renal stones are as common in women as in men, bladder stones are 40 times more common in men than in women

TYPES OF CALCULI —There are four types of calculi

1 *Phosphatic Group*—This includes the calcium, magnesium and ammonium phosphate stones They vary in form according to their location They are of all shapes, molded to the kidney, ureter or bladder, a bladder diverticulum or the urethra They vary in size and are whitish, chalky, crumbly, rough-surfaced stones which cast dense shadows under x-rays

2 *Uric Acid Group*—There are few pure uric acid stones, and these generally are small They are commonly smooth and red, reddish-yellow to dark red in color They occur as sodium urate, potassium urate or ammonium urate combinations They are quite hard but do not cast very dense x-ray shadows

3 *Oxalic Acid Group*—The common form is calcium oxalate These stones tend to be rounded, ovoid or spherical and are the hardest of all urinary calculi They are brown to dark red and are apt to have a very rough, jagged surface capable of abrading tissue with a sandpaper-like action They cast dense x-ray shadows They are more often found without the admixture of other crystalloids than any other urinary calculi

4 *Rare Group*—Under this classification come the calcium carbonate stones, which are chalky and cast dense x-ray shadows because of their high calcium content. They are rare in pure form

Cystine stones are derived from the amino acids through some faulty metabolism.

Xanthine stones are rare. Indigo stones in pure form have been reported but are rare. As their name indicates, they are blue. One of the tests is that these stones will make a blue mark on paper if used as a crayon.

Fibrin stones are old blood clots and are not really calculi.

VI *Sulfonamide Deposits*

It is unfortunate but perhaps not astonishing that the miracle sulfonamide drugs should have some bad effects also. Shortly after the introduction of sulfapyridine and others of this group for treatment of pneumonia, there appeared reports of instances of urinary concretions of these drugs. One report described the case of a female who had been treated for lobar pneumonia two years previously. A large calculus was removed from the pelvis of her right kidney. Analysis of this stone showed large quantities of a sulfonamide mixed with urinary crystalloids.

Numerous reports have shown that sulfathiazole can produce massive obstruction of both kidney pelves and ureters by filling them with an agglomeration of crystals mingled with blood. These crystals are not in themselves opaque to x rays but when mixed with urinary crystalloids can be visualized by x ray. The crystals frequently plug the ureters, fill the kidney pelves and shut off the urine so that anuria is the first sign that anything is wrong. Anuria that occurs with any disease during sulfonamide therapy should be investigated at once by means of the cystoscope and ureteral catheter. The blood levels of the sulfonamide give no clue to this urinary condition.

TREATMENT—Large doses of the sulfonamides are necessary in the treatment of many diseases, but care must be taken to prevent deposits of sulfonamide crystals in the kidneys or ureters. Sodium bicarbonate may be administered by mouth, giving twice

as much sodium bicarbonate as sulfadiazine It is important that the fluid output be maintained above 1,500 cc daily A careful record should be kept and intravenous fluids administered to the seriously ill to keep the urine output above this level The determination of the sulfonamide blood levels and the examination of the urine for crystals should be carried out daily

The best treatment for sulfonamide deposits is ureteral catheterization and irrigation of the renal pelvis with a 5 per cent solution of sodium bicarbonate or with pure distilled water Frequently, on passage of ureteral catheters into the kidney pelves, there will be a gush of urine under pressure, and a fairly well-marked hydronephrosis will be present The ureteral catheters, size no 7 or no 8, should be left in the ureters for 24 hours, and frequent lavage of the kidney pelvis with distilled water, 2–3 cc at a time, should be carried out In addition, fluids should be forced both by mouth and intravenously and external heat applied by means of hot packs or immersion in a tub of hot water (temperature 105 F) Sodium bicarbonate should be administered orally, or an intravenous solution of sodium lactate given if nothing can be taken by mouth

VII Prophylaxis against Recurrence

When small urinary calculi are passed or larger ones removed from the kidney or ureter, the patient is never again troubled with urinary stone formation in 80 to 85 per cent of cases It would seem foolish, then, to subject all persons who had ever passed "gravel" or who had ever had a stone removed surgically to a rigid regime of water, diet and therapy as a prophylactic measure However, there are some important general measures which should be carried out for the benefit of patients who have had renal or ureteral stones removed

1 The patient should report to his physician every six months for two years for K U B roentgen study.

2 He should have a urinalysis every three months, with special reference to specific gravity and microscopic sediment

3 All known infections (tonsils teeth gallbladder liver or else where) should be cleared up if possible

4. Every six months a 24 hour urine specimen should be presented for a quantitative calcium determination. The total normal urinary output of calcium in 24 hours is about 300 mg If the amount is over 420 mg., the calcium output is too high Diluting the urine by increasing fluid intake has no effect on total calcium output, and the diet should be rearranged to restrict calcium intake.

5 The patient should take at least a moderate amount of exercise.

6 He should drink nothing but distilled water

7 Diet should be regulated to avoid increase in weight. The weight should be kept within the limits of the standard age-weight height tables. Diet should be kept balanced at all times, with proper vitamin content added on advice of the physician.

In addition to the subjects touched on, there remains one type of stone disease which may be termed malignant. Victims of this disease fortunately do not constitute a large proportion of lithiasis patients. The disease is advisedly called malignant, for it is just as malignant as the most serious cancer It has the following characteristics

1 The stones recur rapidly after removal

2 The condition is generally bilateral or soon becomes so occurring in both kidneys and sometimes in the ureters

3 It slowly destroys the kidney so that the patient dies of renal failure.

4. It kills in 10 to 20 years So far no cure has been developed.

12

The Ureters and Their Diseases

THE IMPORTANCE of this living, flexible 12 in tube connecting the kidney to the bladder is not appreciated until it becomes the seat of some disease Normally the patient, even if he be a learned anatomist, is completely unaware of the presence of the ureters

The contractions which propel the urine from the kidney to the bladder begin at the ring muscles near the ends of the renal calixes The contraction wave passes down in a continuous progressive peristaltic surge to the bladder This wave is used in identifying the ureter at the operating table When the ureter is struck lightly with an instrument, it responds by setting up contractions or peristaltic waves Curiously enough, a reverse peristalsis occasionally occurs, sometimes strong enough to propel a small ureteral stone up and back into the kidney pelvis The safeguard which prevents urine from the bladder going up the ureter is the ingenious valve formed where the lower end of the ureter enters the bladder The ureter enters obliquely through the bladder wall The oblique implantation and the circular sphincteric muscle fibers form a valve which prevents the urine in the bladder from backing up into the ureter Some diseases of the bladder affect this valve so that regurgitation of bladder urine up the ureter does take place This, however, is a fairly rare occurrence The waves of peristalsis are primarily for the purpose of propelling the urine down the ureter into the bladder The urine is expelled into the bladder in rhythmic spurts in a series of 8 to 10 drops with a pause between

There are, in addition to the peristaltic contraction waves, segmental contractions unassociated with the flow of urine These are the contractions that clamp down on a sharp spiculed stone and hold it painfully in their grasp It is these segmental contractions which we endeavor to relieve by morphine and atropine

URETERAL PAIN DISTRIBUTION —A study of Figure 65, which shows the area of surface distribution of pain sensation arising from the different parts of the ureter will serve to clarify the text. Several years ago we studied ureteral pain distribution We mapped eight levels, measured in centimeter distances up the ureter from the ureteral orifice in the bladder The first was the 30 cm level. We found we always had the stimulating electrode within the pelvis of the kidney at the 30 cm level. The pain from the interior of the kidney is referred to an area at the back. The center of this area is the costovertebral angle, and the area extends over a circle whose diameter is about 10 cm. The 27 cm level brought us to the beginning of the ureter or the ureteropelvic junction. Stimulation here causes pain to radiate downward close to the crest of the ilium. Two centimeters lower, or at the 25 cm level, the pain sometimes moves down as far as the inside of the upper half of the thigh. The rest of the pattern down to the 1 cm. level can best be studied in Figure 65

We feel that these studies are especially helpful in explaining some of the variations of pain distribution found in ureteral stone cases. They explain, for instance, why a stone impacted at the ureteropelvic junction causes intense pain at the end of the penis and why in a similar case, the pain is referred to the heel or to the inside of the sole of the foot.

We were also able to show that the focal point of ureteral pain" is slightly different from the classic point of pain for appendicitis This ureteral focal point was found to be just inside McBurney's point on the right side. This can be of considerable assistance in differentiating appendicitis from acute ureteral obstruction or impacted ureteral calculus.
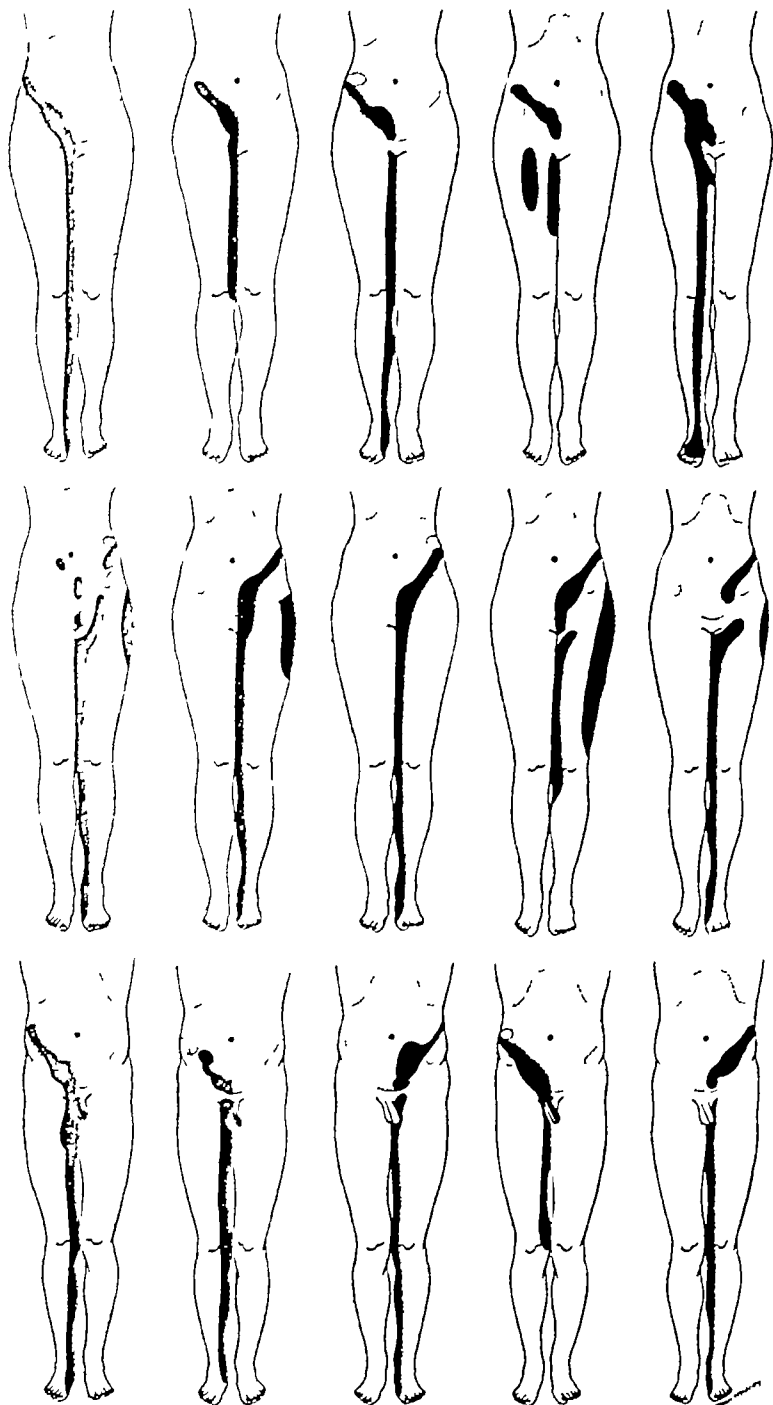
FIG 65 — Total pain distribution from the ureter

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INJURIES.—1 *External Nonpenetrating Violence*—Injuries of such violence as to traumatize the ureter always cause extensive damage to other important viscera. If the patient is in shock, there is not much use trying to find out if there is an injury to the ureter If the injury is to the kidney intravenous urography is the best means of establishing the diagnosis.

2 *Penetrating Force*—Objects such as shell fragments, pieces of glass or metal bullets and other flying missiles may injure the ureter by penetrating the abdomen. Even in war this is a rare injury It sometimes occurs in violent automobile accidents, when glass may penetrate the abdomen and sever the ureter

3 *Injuries at Operation*—Experienced pelvic surgeons some times injure one or both ureters in the course of a difficult operation. Awareness on the part of the surgeon is important. It is embarrassing to find that about the time the patient should be sitting up and looking forward to dismissal from the hospital urine suddenly begins leaking from the wound. In difficult pelvic cases, the surgeon should put his pride in his pocket and ask that ureteral catheters be placed in each ureter before the operation begins. This will permit easy identification and save considerable trouble Sometimes the ureter is severed entirely and the ends are lost in a mass of bleeding inflammatory tissue. If the surgeon knows what he has done, the best procedure is to go high enough on the ureter to identify it, dissect it out and then anastomose it over a ureteral catheter

Two other varieties of injury are common. One is clamping the ureter in an attempt to stop a large bleeder The mousetooth forceps may penetrate the ureter and when the vessel is tied the ureter or part of it, is tied into the mass The ureter later leaks at the point of injury If unobstructed below it may heal by itself The other type of injury is passing a suture through or around the ureter If the suture is passed through the ureter and a deep bite taken into the vagina, a ureterovaginal fistula results. Rectal and abdominal surgeons who do abdominoperineal operations for carcinoma of the

rectum sometimes injure the ureters Perhaps three fourths of these heal spontaneously

If an abdominal or a ureterovaginal fistula results and apparently is going to become permanent, one should wait three months, then reimplant the ureter in the bladder It is necessary to wait because before this time the tissues are not easily identified and worked with and healing will not be so good

Passage of catheters into the ureter may injure this delicate tube A number of cases have been reported in which injury followed attempted instrumental removal of ureteral stones with various instruments Usually these injuries heal, but severe periureteral retroperitoneal abscesses are sometimes formed. The surgeon who undertakes to remove a calculus from the ureter with an instrument such as the Johnson stone basket or the Howard spiral should be qualified and also prepared to do an open operation in case he gets his instrument on the stone and cannot dislodge either the stone or the instrument. As in kidney surgery, only "a God-fearing surgeon should undertake ureteral surgery"

STRICTURE —At one time this was a controversial subject among urologists Most authorities agree that there are two varieties, congenital and acquired.

Congenital —This variety is usually discovered in childhood.

It would be well to define ureteral stricture before going further A stricture is a narrowing of the lumen of the ureter by an inflammatory process in the walls of the ureter or in adjacent structures The inflammation in the walls of the ureter ends by laying down circular yellow elastic fibers that interlock and tend to contract when the original inflammatory process subsides The inflammation in adjacent structures may end by forming a hard scar which completely surrounds the ureter and compresses it.

Congenital strictures are usually dense fibrous contractures that occur at the ureterovesical insertion and at the ureteropelvic junction. They are, then, commonly formed at the upper or the lower end of the ureter Rarely are they found between these points

Acquired—Instrumental trauma may cause stricture in the ureter Ureteral stones when impacted for a long time may give rise to scarring which will result in stricture formation. Trauma to the ureter during surgical operations whether on other viscera or on the ureter itself may produce strictures.

Surgical removal of impacted ureteral calculi may be followed

FIG. 66.—Bilateral ureteral stricture in a male, showing only right ureter and kidney pelvis, with ureter making complete spiral turn. Similar condition was present on the left.

by stricture Plastic operations on the kidney pelvis may fail because of the perversity of the ureter in forming strictures and becoming for all practical purposes obliterated. The pressure of an aberrant renal artery on the ureter and fibrous constricting bands which some times represent obliterated aberrant renal vessels may cause stricture In all these cases stricture is due to chronic inflammation.

TUBERCULOSIS OF THE URETER —This can scarcely be considered apart from renal tuberculosis Since the infected urine from a tuberculous kidney must pass through the ureter, it is not difficult to see that the ureter must partake of the renal infection above In a few cases of renal tuberculosis, the ureter escapes infection and remains normally soft and pliable When the ureter is invaded by acid-fast bacilli, it thickens and the diameter becomes several times normal In thickening it also shortens, so that in the roentgenogram it appears straightened or splinted This shortening causes retraction of the lower end out of the bladder to form the "golf-hole" ureteral orifice The strictures formed by this disease are multiple and sometimes practically impassable Secondary infection often causes as much damage as do Koch's bacilli

URETERITIS AND URETERAL SPASM —Ureteritis means an inflammation of the ureter itself Sometimes the cause is obscure The infection by tuberculosis produces a special type of ureteritis, already described Ureteritis is commonly associated with infections of the kidney That associated with ureteral stone sometimes is the source of as much pain and discomfort as the stone itself

Ureteral spasm is often associated with disturbances of the sympathetic and parasympathetic nervous systems Such important diseases as intestinal obstruction, appendicitis and infarct of the kidney are commonly accompanied by marked spasm of the ureter It is impossible to pass ureteral catheters through these spasms Ureteral spasm may be as painful as ureteritis or ureteral calculus and, indeed, mistaken for either

EXTRINSIC DISEASE AFFECTING THE URETER —Large fibroids sometimes produce enough obstructing pressure so that hydronephrosis is formed above the obstruction Abscesses, such as appendical and pelvic abscesses, may affect the ureter Neoplasms, particularly those in the cervix, often enmesh the ureter in a fibrous mass The end-result of cancer of the prostate is somewhat similar Papilloma of the bladder may extend along the ureters and spread out as a hard cake of carcinoma enclosing the ureters

URETERITIS CYSTICA.—This rare disease occurs more often in the bladder than in the ureter It consists of small hard vesicles in the mucosa, often seen in the roentgenogram as dark spots giving the ureter a mottled appearance (Fig 67) They have been called

FIG. 67—Striking example of ureteritis cystica (Courtesy of Dr Benjamin F May St. Louis.)

cell nests and are said to resemble, in some respects, malignant cellular changes

LEUKOPLAKIA.—This is a rare disease of the ureter It usually is an extension from leukoplakia of the bladder It is generally considered to be a precancerous lesion.

GRANULOMAS.—These occur as small tufts or patches on the mucous membrane of the ureter They are usually due to chronic inflammatory changes They will set up ureteritis.

NEOPLASMS—Approximately 150 cases of primary cancer of the ureter have been reported Early diagnosis is important Once the carcinoma breaks down, it is too late for surgical cure The diagnosis can be made from the ureterograms by any competent urologist or roentgenologist (Fig 68)

Endometriosis is a rare condition The one case in all the litera-

FIG 68—Primary papillary carcinoma of the ureter in a woman, 75

ture of the world is reported by Alexander Randall This is not a true malignant disease but has more the nature of ectopic endometrial tissue

ANOMALIES—These were discussed in Chapter 10

ACUTE URETERAL OBSTRUCTION—Acute ureteral obstruction should be more often suspected than it is Any obstruction of a ureter, whether by impaction of a ureteral calculus or closure of a stricture, may cause acute obstruction Many cases of so-called acute pyelitis are, in reality, cases of acute ureteral obstruction

Acute ureteral obstruction causes symptoms that vary with the length of time the obstruction is present and the severity It fre quently happens that if seen early the systemic disturbance will be quite mild. If the obstruction is complete and a staphylococcic in fection is present, the patient may be profoundly ill A certain set of symptoms is present, although it cannot be said that there is a characteristic syndrome

Pain is the most important and constant symptom It can be and generally is in the kidney area and is due to distention or hydrone phrosis from blocking of the ureter Onset may be sudden or gradual *Chills* may be present, caused by reabsorption of infectious material from the kidney *Vomiting* and *nausea* sometimes become promi nent. The hydronephrosis may have become large enough if on the right side to press on the duodenum. There may be enough retention of nitrogenous waste products in the blood stream to border on uremia or the uremic state. *Leukocytosis* varies consider ably The leukocytes may vary from 12 000 to 48 000 The sudden onset of the obstruction with accompanying staphylococcic infection often produces a high leukocyte count. The final diagnosis, and at the same time the treatment procedure, is apparent when a ureteral catheter is passed by the obstruction and urine gushes out under pressure. The patient is almost at once relieved of his symptoms.

HYDRO-URETER AND PYO-URETER.—Hydro-ureter almost never occurs without a corresponding hydronephrosis above. It is, there fore, part of a larger clinical picture.

Pyo-ureter means a ureter filled with pus. This too is not a clinical entity but part of a more extensive pathologic process

Empyema of a ureter is a term that has been applied to the con dition of pus in a ureteral stump Usually after nephrectomy as much as three fourths of the ureter is left in situ. Sometimes infec tion persists in this dilated ureteral stump The term empyema of a ureteral stump has been applied although the term "empyema" is commonly used to designate pyemic chest conditions.

FISTULAS.—Ureteral fistulas are not uncommon. They occur as

ureterocutaneous, ureteroperitoneal, uretero-intestinal and uretero vaginal

It was a ureterocutaneous fistula that became the indication for nephrectomy in the first planned operation of its kind, done in 1869 by Gustave Simon

Fistula of the ureter results from injury or disease The injury may be external or operative Ureterocutaneous fistulas are self-evident and usually follow operation The ureteroperitoneal fistula may be fatal if the urine cannot escape from the peritoneal cavity

Uretero-intestinal fistula occurs to various parts of the intestinal tract, usually to the colon, sigmoid or rectum Such fistulas form from inflammatory disturbance Diverticula of the large bowel may attach themselves to the ureter and by an inflammatory process erode through to form the communication

The most troublesome fistula and the one most difficult to diagnose is the ureterovaginal fistula It is almost always at first mistaken for vesicovaginal fistula This fistula commonly follows injury to the ureter by placing a suture through it and through the vaginal wall in the course of a pelvic operation

TREATMENT —There is practically no medical treatment for any of the diseases and disorders of the ureter Surgical treatment is of two types open and closed or cystoscopic surgery Space does not permit a description of either type of surgical procedure

The Urinary Bladder and Its Diseases

THIS PINT SIZED saccular musculomembranous reservoir for liquid waste products is highly important to the functioning of the human body Normal urine which is irritating to any other tissue of the body has no untoward effect on healthy bladder mucosa.

The idea that if the bladder is cut it never heals has been dispelled by modern surgery Far from not healing, the bladder when opened for drainage sometimes does too good a job of healing That is when we need to keep the bladder open for drainage its remarkable healing properties tend to close it as quickly as possible.

Because of the violence of so many accidents which frequently result in fracture of the pelvic bones and rupture of the bladder we urologists constantly preach the doctrine "Empty the bladder before joy riding," "Micturate often when on long automobile trips," or "Evacuate your bladder before battle." The empty bladder is not easily ruptured. This organ was the original model for the self sealing gasoline tank. Unless the bladder is distended a bullet wound or small stab wound will be almost self sealing and little leakage will take place. Immediate and continuous catheter drainage to such a wounded bladder to collapse it and put it at rest will cause spontaneous healing in a large percentage of cases.

That the bladder is subject to many diseases and disorders is almost self-evident. Bladder stone disease was included in Chapter 11 so is not discussed here. The doctor who practices general medicine may treat successfully many of the more simple bladder

disorders if he will prepare himself to recognize them He will be rewarded by having many grateful patients

For anyone who undertakes to treat, either medically or surgically, the diseases and disorders of the urinary bladder, a thorough knowledge of its structure and function is necessary In children, until about the fifth year, the bladder is partly an abdominal organ It rides high in the pelvis and when distended extends up into the abdomen Thus a distended bladder in an infant or young child may easily be mistaken for an abdominal tumor The bladder does not attain its adult position until late in puberty

The bladder capacity varies considerably in different individuals It may normally fluctuate from 250 to as much as 600 cc The bladder is a hollow muscular organ, with three interlacing smooth muscle coats, a fibrous outer coat and a mucous membrane lining within It is extraperitoneal On its upper part it has adherent to it a reflected layer of the peritoneum It lies in front of the rectum In the female, the cervix and the vagina are attached to the bladder by connective tissue and lie posterior to it In the male, the prostate causes the bladder to be a little higher in the pelvis than in the female

The mucous membrane consists of several layers of stratified transitional epithelium As the bladder shrinks or distends, this mucous lining becomes thicker or thinner The mucosa contains no glands The trigon is that triangular area formed by the two ureteral orifices and internal urinary orifice The average measurement of the sides of this equilateral triangle is 1 in but varies as the bladder changes size The epithelium of the trigon is mesodermal in origin, arising embryologically from the mesonephron

Two ligaments derived from the pelvic fascia hold the bladder in position below The urachus is a fibrous band attached to the umbilicus and is the remains of the allantois

The rich blood supply is derived mainly from the internal iliacs through the superior and inferior vesical arteries In the female, branches of the uterine artery reach the posterior part of the blad-

der The bladder has a very complete anastomosing system of vessels. The lymph network is present everywhere in the bladder except in the mucosa.

The nerve supply to the bladder is complicated and is bilateral. The nerves are derived from the accessory and autonomic systems. The autonomic nerves, both sympathetic and parasympathetic, form a plexus on both lateral aspects of the bladder Learmonth called attention to the importance of the presacral nerves. There are two sets of nerves to the bladder the sympathetic nerves, which close the sphincter and relax the bladder so that it can fill, and the parasympathetic nerves, which relax the sphincter and cause contractions of the bladder muscle so that it can empty

Many pages would be required to describe in detail the apparently simple act of micturition or emptying the bladder It is generally assumed that when the bladder is full the mere quantity of urine in the bladder initiates the desire to urinate, but much experimental work has proved that this is not the case. Actually the tonus of the muscular walls of the bladder sets up the desire to empty the bladder in the form of a stretch reflex. When the bladder has lost its tone, as in tabes, the desire to urinate is not initiated until a large quantity of urine has sharply distended the bladder In doing a cystoscopy on the normal bladder if one fills the bladder rapidly with too cool a solution, the desire to urinate is initiated long before the capacity of the bladder is reached.

Normally urination occurs five to eight times in 24 hours, during which period 1 000-2,500 cc. of urine may pass. There is a wide normal variation in urinary output. In cold climates or cold weather where the individual perspires little, the output of urine is increased. In some hot climates where the temperature reaches 120-130 F., the average individual will empty his bladder only once or twice in 24 hours the total volume being markedly diminished.

It is important to note that the bladder does not permit absorption of either water or water soluble toxins into the general system. The classic experiments of Macht are well known potassium cya

nide placed in a dog's urethra promptly caused death, the same amount placed in the bladder caused no untoward effect.

Cystitis

Cystitis simply means any inflammation of the urinary bladder Many agents may be responsible for cystitis A great variety of bacteria can be the cause The list would include all the pathogenic bacteria, for they have all been found in the bladder at various times The tubercle bacillus is often guilty Syphilis may produce a rare type Bilharziasis (Schistosoma haematobium) may become much more important in the future than it is at present The modern treatment of gonorrhea has almost eliminated gonorrheal cystitis from consideration, although it still is something to reckon with. There is much needless confusion concerning cystitis Regardless of the causative factor, the symptoms are the same

Symptoms - The following symptoms are classic

1 Urinary disturbances, frequency, painful urination, strangury, tenesmus, and pain are always present in varying degrees

2 Sometimes there is gross hematuria Pus and blood are always found microscopically (The one example of cystitis without pus is Hunner's ulcer which we discuss fully later)

3. Retention of urine may be partial or complete Incontinence of urine may be present

SIMPLE CYSTITIS —The patient is generally a woman, cystitis being almost 10 times more common in women than in men Many cases of cystitis are self-limiting, that is, the patient does not consider it important enough to go to a doctor Finally the patient recovers or enters a tolerable state of chronicity Many such cases are not seen by any doctor This was much more common in former generations when modesty kept the female patient from discussing so private a matter with her doctor

The patient complains of the classic symptoms previously mentioned. The first step in diagnosis is to obtain a catheterized urine specimen for thorough examination. The sediment is examined

under the microscope and pus and blood cells are identified. Some of the fresh urine should be shaken and with a small pipet a drop or two placed on the counting chamber and the pus cells enumerated. The number should be recorded to provide a guide to the progress and effect of treatment. (The counting of pus cells in the urine is described in detail on p 20.)

The next step is to spread some of the sediment from the centrifuged specimen on a slide and dry and stain it with methylene blue. Often the infecting organism is identified in this way.

Treatment —The treatment of simple cystitis is not usually difficult.

1 A soft rubber catheter no 20 is passed in an aseptic manner and the bladder emptied.

2 A 2 per cent solution of metycaine or a 1 1 000 solution of nupercaine in the amount of 10 cc. is then instilled into the bladder through the catheter the catheter is clamped with a hemostat, and the anesthetizing solution is allowed to remain for five to eight minutes.

3 This solution is allowed to run out until the bladder is again empty Then 10 cc., or 2 teaspoonfuls, of a 10 per cent neosilvol solution is prepared and mixed thoroughly with 5 drops of 2 per cent silver nitrate solution. The solution is instilled in the bladder and the catheter withdrawn, leaving the solution in the bladder The patient remains quiet on the table for five minutes and is asked to retain the solution as long as possible (usually an hour)

4 By mouth, one of the sulfonamides is given preferably sulfacetimide or sulfathiazole, in 7½ gr doses three times a day after meals.

5 The patient should rest as much as possible

6 Amytal 1½ gr or seconal ¾ 1½ gr at bedtime allays nervousness and promotes restful sleep

We have found this procedure extremely satisfactory in office practice for 20 years. Four of every five cystitis patients will require not more than three treatments on successive days. If the pus does

not disappear, the urine become sparkling clear and all symp
vanish, the physician can be sure that he is not dealing with su
cystitis and should further his investigation into the cause o:
bladder disorder

ENCRUSTED CYSTITIS —This is actually a rare form of ch:
cystitis, usually due to infection of the bladder with Bacillus prc
one of the salmonella group It is a urea-splitting organism and
produces ammonia which precipitates the phosphatic, calcium
magnesium salts that adhere to the walls of the bladder as wh
deposits Sometimes these flakes become the starting point for
stone formation The cystoscopic view is unmistakable

Treatment —1 The infection must be eliminated if poss
Mandelic acid is valuable, given in 3 Gm doses four times a
Sometimes the stomach rebels at so much medication, requirin
0 5 Gm tablets at each dose It is most easily kept down and i
effective if given just before meals

2 Sulfacetimide or sulfathiazole in 7½ gr doses three t
a day after meals is valuable and can be alternated with
mandelic acid The sulfonamides tend to alkalinize rather tha
acidify the urine

3 If possible, the patient should be put to bed and a 5 cc F
balloon catheter of 22 F size placed in the bladder An irrigate
set up and filled with 2 per cent acetic acid solution warme
body temperature The bladder is irrigated every half-hour, u
about 50 cc of the solution at a time Hydrochloric acid is n
effective, but since it is more irritating cannot be used in stre
of more than 1 per cent

4 Acid ash diets are helpful in keeping the hydrogen ion
centration, or pH, of the urine down around 5 0 It is someti
difficult to keep the urine constantly acid

ULCERATIVE CYSTITIS —This could as well be called subacut
chronic cystitis Neglected simple cystitis may become ulcerat
The ulcers are flat and superficial and usually are covered wit
shaggy film of cast-off epithelium

The treatment is the same as that for simple cystitis (see p 229)

TUBERCULOUS CYSTITIS.—This disease is almost never primary in the bladder In more than three fourths of cases of renal tuberculosis, cystitis is the outstanding complaint. It is important first to establish the diagnosis. Finding the acid fast bacilli (tubercle bacilli) in the urine is the quickest way to arrive at correct diagnosis. Long chronicity should cause one to suspect tuberculosis. Usually the cystitis has existed for several months. Ordinarily the bladder has a limited capacity and urination occurs every 15 minutes to one-half hour day and night. The cystoscopic appearance of the bladder is always characteristic and is recognized at once by the experienced cystoscopist.

Treatment—Treatment of the bladder is necessary in renal or genital tuberculosis as a preliminary to surgery as after treatment to clear the bladder of infection and in inoperable cases for palliation. We have found the following procedure effective

1 Attention to diet and rest is essential (see pp 115 116) Regulation of bowels and water intake is important

2 To eliminate the secondary infection sulfacetimide or sulfathiazole is given in 7½ gr doses four times a day

3 For local treatment we have used Gomenol a proprietary preparation of cajeput oil It is used in 4 5 cc. amounts warmed to body temperature and instilled directly into the urinary bladder We have modified Rovsing's method using as a preliminary 1 1 000 nupercaine solution and after 10 minutes instilling 10 cc of a 2 per cent phenol solution Phenol has the property of anesthetizing skin and bladder mucosa is more nearly like skin than any other mucous membrane.

We also use an oily preparation which has proved effective in tuberculous cystitis.

Metaphen in oil A 1 1,000	100 cc.
Anesthesin	1 Gm.
Phenol	1 Gm.

Mix and use as a bladder instillation.

This mixture can be instilled directly into the empty bladder, where the oil is usually trapped and remains as oily droplets for several days Usually two or three such treatments per week keep the patient with chronic inoperable tuberculous cystitis comfortable

SYPHILITIC CYSTITIS —This usually occurs in late syphilis and entirely apart from the effect of the bladder paralysis from tabes It is seen chiefly in males It has all the classic symptoms of cystitis and is exceedingly painful The diagnosis may be suspected from the intractable nature of the disease

Ordinary treatments to the bladder have no effect Usually the blood Wassermann reaction is 2+ or 4+ One or two intravenous injections of neoarsphenamine will, with magic promptness, cure the cystitis

GONORRHEAL CYSTITIS —This is now only of historic interest. However, a quarter of a century ago it was common in gonorrheal urethritis, particularly the acute posterior form Sulfonamide and penicillin therapy of gonorrhea has completely eradicated this complication It occurs in both males and females, but is always more painful and severe in males The diagnosis can be made from a smear from the urethra or, if there is no discharge, a smear from the urinary sediment will show the gonococci

Treatment —The following procedure will cure in four days to a week

1 The bladder is irrigated with silver nitrate 1-20,000, or

2 The bladder is anesthetized with 1 1,000 nupercaine solution, and after 10 minutes 10 drops of a 1 per cent silver nitrate solution is instilled

3 Sulfathiazole is given by mouth in doses of 1 Gm four times a day

BILHARZIC CYSTITIS —This disease is caused by Schistosoma haematobium It is named for Theodor Maximilian Bilharz (1825-1862), who in Egypt in 1851 discovered the parasite, a blood fluke, and associated it with the disease of the urinary tract While this disease is rare in the United States and Europe, it is common in the

southern Mediterranean countries and endemic in South Africa, Uganda Syria, Turkey Greece and Egypt. In Egypt the special hospitals in 1934 were treating an average of 250,000 cases each year

There would be no point in calling attention to a disease which is rare in our country except for the fact that our soldiers who lived in these regions during the war have brought home with them this, to us, new disease It is, in fact, not new, for ova of Schistosoma haematobium have been found in the bladders of Egyptian mummies of 1250 B C.

Three schistosomes are included in the term "bilharzia" (1) Schistosoma mansoni, in rectal lesions, (2) Schistosoma Japonicum in lung and liver diseases, and (3) Schistosoma haematobium which invades the urinary tract of man. This schistosome is a uni sexual worm which completes its sexual cycle in the portal circulation of man and its asexual cycle in the digestive tract of certain snails. Like the discussion as to which is first, the hen or the egg, one cannot say whether the snail was infected first or man. We do know that the disease cannot continue to exist without the right species of snails to complete the asexual cycle It was not until Lieper headed the Bilharzia Mission to Egypt in 1915 that the life cycle of this interesting parasite was clarified.

The asexual phase starts with the infected human being, whose urine containing the ova passes into a pond, stream or other fresh water reservoir where live the snails. The ova hatch in the fresh water into ciliated embryos which, within 24 hours, enter the snail and find their way to the digestive tract. Here they remain for six weeks and develop into sporocysts inside of which the daughter cysts develop These daughter cysts burst and discharge the cercariae which are liberated into the water by the snail

In the sexual phase, these cercariae swim around in the water looking for a human victim. Within 28 hours they penetrate the skin or mucous membrane and enter the veins After an incubation period of about one month they reach the lungs by the venous circulation. They then pass to the liver where they develop into

mature male and female worms The male is thin and flat like a leaf, is about 12 mm long and it has suckers and some tubercles The female is larger, round and 20 mm long The worms pass into the portal circulation where the male and female unite and move on to the larger veins of the bladder The female at this point leaves the male and goes to the finer venules beneath the bladder mucosa and deposits her eggs Some of these eggs are liberated and pass out through the urinary stream, and the cycle begins all over again.

The symptoms of the disease are those enumerated for cystitis

Treatment —The history of treatment of the disease is of interest. For centuries no treatment was available In 1912 tartar emetic or potassium and antimony tartrate was given intravenously with excellent results Use of tartar emetic had certain drawbacks, for the solution had to be made up fresh, and if even a tiny portion of a drop got outside the vein a painful sterile abscess would result. In 1930 an organic antimony compound was made which was much safer and could be given intramuscularly It was named fuadin after King Fuad of Egypt. The use of fuadin for human beings and copper sulfate on the snails could result in eradication of the disease

HONEYMOON CYSTITIS—In Chapter 3 we wrote concerning honeymoon pyelitis and suggested the nature of this disease Cystitis is so often part of the picture that we call attention to it again.

STERILE CYSTITIS—In this severe cystitis, occasionally encountered. no organisms are found, the symptoms are usually severe, the urine often bloody. The condition responds only to arsenicals given intravenously Penicillin and sulfonamides are without effect. Tuberculosis must always be ruled out.

HUNNER'S ULCER (SUBMUCOUS FIBROSIS, ELUSIVE ULCER) — In the United States this disease is designated Hunner's ulcer, but it has many names The term ' ulcer" is not entirely descriptive

Alexander Skene (Brooklyn, 1838-1900) is said to have described it as "interstitial cystitis" It was not until Guy Hunner described the lesion and called attention to it in 1914 that urologists began seriously to look for it Skene did not have the cystoscope so

he could not have known accurately just what he was describing

Etiology—Despite a good deal of study the etiology remains a mystery It is common in women and when discovered is usually of long standing It is rare in men. We have seen the ulcer in the male bladder in only five cases Some believe it has a bacterial origin, but it is difficult to explain its predilection for females and

FIG. 69—End-result of untreated and neglected Hunner's ulcer in woman with a typical history

also for the dome and right half of the bladder It seems to have no relationship to any other disease

Pathology—Many many sections have been taken for microscopic study, and they all show the same disappointingly small amount of uninteresting chronic inflammation. The pathologists say that there is nothing in the microscopic picture to distinguish it from any chronic inflammatory process with granulation tissue. Sometimes the microscopic section shows that the mucosa is intact over the area of granulation. There are usually both polymorphonuclear cells and round cell infiltration. The blood vessels are usually numerous. The disease is often confused with tuberculous lesions of the

competent urologists fail to reveal the ulcer We have observed such cases, and generally by making a cystoscopic examination every month the lesion was finally discovered.

Treatment —There has been a great deal of unnecessary pessimism regarding the results of treatment of Hunner's ulcer We find that in 80 to 85 per cent of the cases relief is permanent after about two years of treatment and follow up

The older treatments, such as irrigation with various solutions and dilatation of the bladder with fluid under pressure and under anesthesia, brought no satisfactory benefits. Surgery in the form of resection of small or large portions of the bladder containing the ulcer was also disappointing

The best treatment in our hands includes thorough fulguration of the ulcer under pentothal sodium anesthesia. This is followed by instillation of 1 oz. of 2 per cent silver nitrate solution. After two minutes 2 oz. of normal saline solution is placed in the bladder The salt solution precipitates the silver in the form of silver chloride and stops the action of the silver nitrate The whole is washed out and the patient put back to bed. In three weeks the bladder is inspected with the cystoscope and if remaining lesions are seen, the treatment is repeated.

Nothing in the way of diet or antiseptics by mouth seems to do any good. On behalf of women who complain of bladder trouble for which the average physician can find no cause, we plead that they not be condemned as neurotics until Hunner's ulcer has been ruled out.

Tumors

It would seem that if every case of gross total, massive, painless hematuria were diagnosed papilloma of the bladder the physician would be right 90 per cent of the time In few other diseases can the diagnosis be so accurately made from one symptom or sign. The importance of painless hematuria cannot be overstressed. Physicians are still giving patients medicine to stop hematuria. Com

monly, the patient comes to the doctor to say that blood was passed in the urine "this morning" The doctor asks a few questions and, finding that no pain was associated with the hematuria, writes a prescription The doctor is more surprised than the patient when
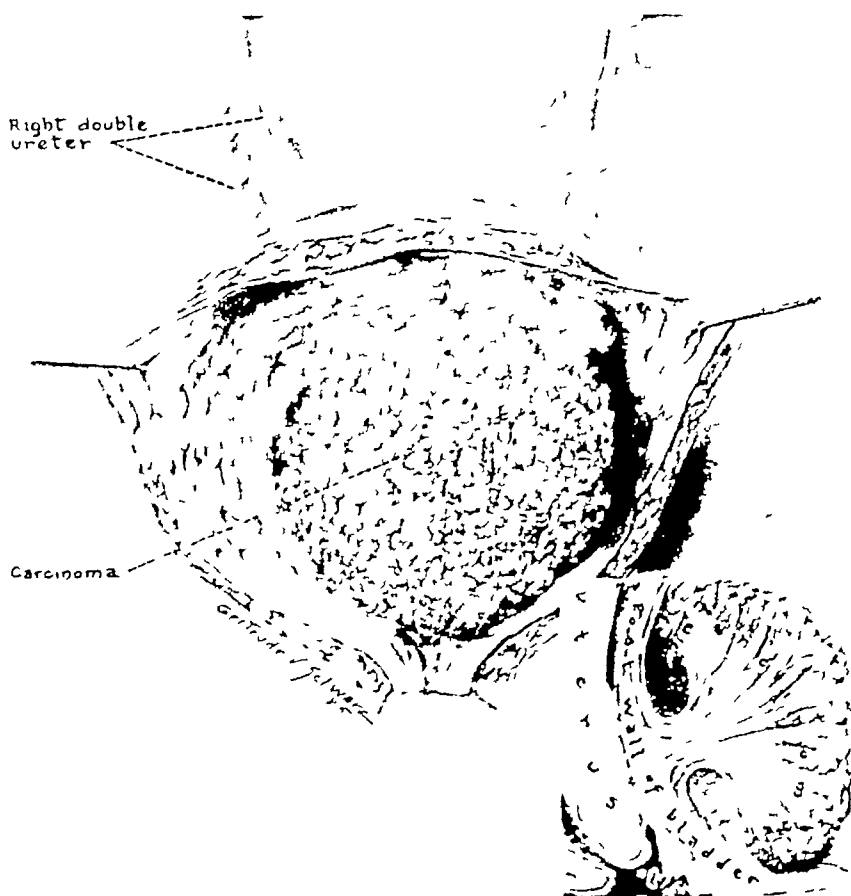
FIG 70 —Papillary carcinoma removed from bladder of woman, 59 Five years later, when she died of extensive retroperitoneal metastatic carcinoma, the bladder was clear

the hematuria ceases, but the patient believes implicitly that the medicine cured him The bleeding may cease for several months or even a year Meanwhile the tumor is growing

It is important to investigate every instance of hematuria by cystoscopy The diagnosis can be immediately and completely estab

lished. Medical authorities of the early eighteenth century wrote "The diagnosis of these tumors is as uncertain as their treatment." Now we can write that the diagnosis is easy and sure and the treatment remarkably successful in the early cases.

The incidence of bladder tumor is higher than generally thought. In considering urologic cases alone seen in large hospitals, cases of bladder tumor constitute between 3 and 4 per cent of the total. Of all human tumors, incidence of bladder tumor is around 0 5 per cent.

Prior to the perfection of the cystoscope, the diagnosis of bladder tumors was uncertain. Indeed, there probably were not as many bladder tumors as now We have markedly increased the average length of life and with it have increased the incidence of malignant disease. In 1885, Antal found only nine bladder tumors on record with operation through a suprapubic approach.

Little is known regarding causative factors. We know that warts on the skin and papillomas of the bladder are somewhat similar in structure. They are generally formed as a result of irritation. The bladder is so well protected that it is generally free from external influences. We know that in cases of exstrophy of the bladder in which the bladder is exposed and subject to mechanical irritation, epitheliomas develop frequently On the other hand, considering the number of bladder stones which develop papilloma of the bladder is a rare accompaniment.

We have also to consider that most bladder tumors develop in an apparently normal bladder in the presence of sparkling clear apparently normal urine. With our knowledge of the carcinogenic chemicals, we may well suppose that the urine of certain individuals may contain minute quantities of these cancer producing substances. Since the mucosa of the bladder is constantly bathed in urine which contains these substances, it is reasonable to suppose that they can act to produce cellular change which will develop into a new growth Some authorities insist that 40 per cent of all bladder tumors are benign papillomas, but a study of the natural history of bladder tumors tends to refute that idea. We have seen many tumors re

ported by the pathologists as "benign" or "no malignancy seen" which have recurred to the destruction of the patient We insist that there are no benign bladder tumors All bladder tumors, if left alone, will destroy life

True enough, there are different grades of malignancy Broders' classification, based on certain cellular characteristics, which divides these tumors into four groups, is excellent We find from long experience that we can grade the bladder tumors as accurately with the cystoscope as the pathologist can with his microscope Broders' grading is very convenient, grade 1 being the lowest in point of malignancy and grade 4 the most malignant Grade 1 tumors tend to change their form to one of the higher groups The change is never from higher to lower grades

Pathology —Ninety-five per cent of tumors of the bladder are of epithelial origin The other 5 per cent present a wide variety of primary growths We will here consider only the 95 per cent group

Two general groups suffice for our classification

1 Papillary group
   a) Low grade papilloma on a small pedicle
   b) Papillary carcinoma—superficial
   c) Papillary carcinoma—infiltrative
2 Papillary infiltrating group
   a) Adenocarcinoma
   b) Squamous cell carcinoma

These tumors have some inherent peculiarities They remain in and confined to the bladder for a long time Many never metastasize Some spread by implantation It would seem as if they seeded and the seeds took root They have been known to implant themselves in the wound following suprapubic cystostomy

They may form in a diverticulum of the bladder (Fig. 71) and so be hidden for too long We have had many cases in which there were metastases to the lung Patients with grade 4 solid infiltrating carcinomas present a sad picture, and some cases are hopeless from the time they are discovered

Treatment —In most of the early cases cystoscopic treatment is best. In 1910 Edwin Beer began to use the high frequency electric current to coagulate these tumors, using an insulated wire which he passed through the cystoscope into the tumor His results were so good that this method is practically universally used

The Nesbit modification of the Stern McCarthy resectoscope has given us additional advantages and allowed us actually to resect the tumors in a sound surgical manner The procedure is difficult and

FIG. 71 —Papilloma inside a bladder diverticulum. *Left* diverticulum after being separated from the bladder before opening. *Right* pouch opened, showing papilloma inside. Diagnosis was based on cystoscopic appearance and cystograms.

requires considerable cystoscopic experience. In addition to removing the tumor completely by resection we insist on implanting platinum radon seeds through a cystoscope into the base of the tumor or in the spot where the tumor base was.

The open operation should be resorted to whenever one is doubtful about the extent of a bladder growth Even experienced cystoscopists are mistaken at times as to the extent of a tumor Occasionally when there is little cystoscopic evidence of tumor the growth has infiltrated a large area of the bladder wall In open operations, the suprapubic extraperitoneal approach should be used. The tumor should be dissected free by the high frequency cutting electrode or radio knife and the base of the tumor properly irradiated with radium. Roentgen therapy we have found to be of no value for bladder tumors.

Diverticula

Diverticulum of the bladder is an outpouching of the bladder which is abnormal Diverticula may be large or small, single or multiple (Fig 72) Frequently these pouches are as large as, or larger than, the bladder itself All we know about these strange sacculations has been learned since the beginning of the twentieth century Prior to that time there was practically nothing in the American literature and little in the foreign literature concerning this interesting disease
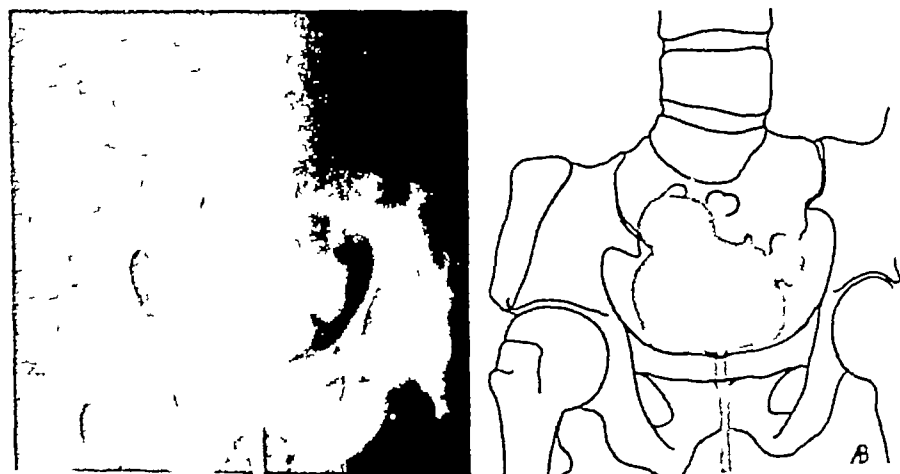
FIG 72—Typical multiple diverticula of the bladder complicating prostatic hypertrophy

Its origin is not surely known There are three theories of formation (1) congenital, (2) acquired, because of obstruction, and (3) congenital weakness of the bladder wall, plus obstruction. None is completely satisfactory

Since 1900 hundreds of cases have been reported and a voluminous literature has sprung up The greatest number of diverticula occur in men past middle age Only a few cases have been reported in children The disease is rare in females, a large collected series shows only 3 5-5 per cent in women In children the ratio is one female to every five males

All the cases we have had were associated with obstruction of the vesical outlet. The commonest obstruction is prostatic hypertrophy. We believe that practically all diverticula are acquired. There may be something to the theory of a line of demarcation being formed in the embryo producing small, weak or defective areas in the bladder wall. When obstruction is added to this, the diverticulum forms.

Symptoms—There are no characteristic symptoms referable to a diverticulum. One may suspect its presence when the patient states that he can void a fairly large quantity of relatively clear urine, then change position and in a few minutes pass a still larger amount which is cloudy and thick with pus. Sometimes the patient states that he has the feeling of never being able to empty his bladder completely.

The diagnosis is made by cystoscopy. The size and exact location of the diverticulum are shown by x rays. The bladder is first emptied then filled with sterile water or sterile boric solution. This is then drawn off and measured. The same amount of 5 per cent sodium iodide solution is then used to fill the bladder. Stereoroentgenograms are made followed by oblique plates. Next the fluid is allowed to run out and a plate is made with the bladder apparently empty. This last plate will frequently show the diverticulum standing out by itself.

Treatment—There are only three methods of dealing with a diverticulum, all surgical.

1 The obstruction is removed and nothing further is done except to clear up the infection. This method should be used in the aged and feeble. Diverticulectomy is a major operation and the aged are sometimes poor surgical risks.

2 The bladder is opened and the neck of the diverticulum enlarged so that it is no longer a bottle-necked pouch but an auxiliary bladder. This method can be used on large diverticula that open into the trigon and lie posteriorly between the bladder and the rectum.

3 Through a suprapubic opening, the peritoneum is stripped upward off the bladder, the urachus cut and the bladder completely mobilized and filled with fluid Care is taken not to open the bladder The diverticulum is completely freed until its attachment to the bladder is cleared The fluid in the bladder is allowed to run out. The neck of the diverticulum is then clamped and cut away The stump is tied and inverted into the bladder and the muscle layer properly sutured with fine chromic catgut

In any case the obstruction at the bladder neck, whether prostatic hypertrophy, congenital fibrous contracture, stricture of the urethra, tumor or whatever the cause, must be removed.

Fistulas

Fortunately there are only three varieties of vesical fistulas, vesicovaginal vesico-intestinal and vesicocutaneous (Fig 73)

VESICOVAGINAL FISTULAS —It seldom takes a very smart doctor to diagnose vesicovaginal fistula The patient complains that urine leaks constantly through the vagina All the doctor has to do is nod his head

The large fistulas are easily located with a speculum, the tiny ones which are apt to be high in the vaginal vault may be difficult to find One may have to use cystoscopy or fill the bladder with a weak solution of indigo carmine to find the fistulous opening The dye will come through the fistula, disclosing its location

Opinion as to the cause of vesicovaginal fistula, formerly attributed to long labor which produced pressure necrosis of the bladder, has changed It is now believed that few are caused by accidents incident to childbirth Most of them result from accidents during pelvic operations Wild clamping with en masse tying of vessels or placing of deep sutures with a curved needle may result in a vesicovaginal fistula

The cure is surgical, and only the experienced should tackle this problem
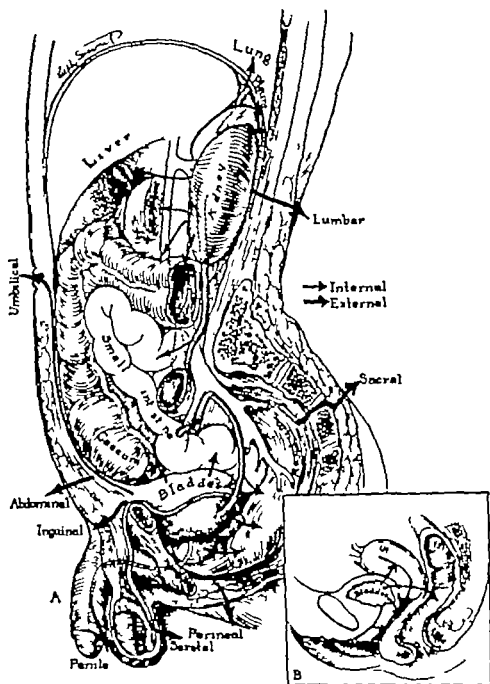
FIG. 73.—Various types of urinary fistulas. (From Hinman *Principles and Practice of Urology* Saunders, 1935 p. 924.)

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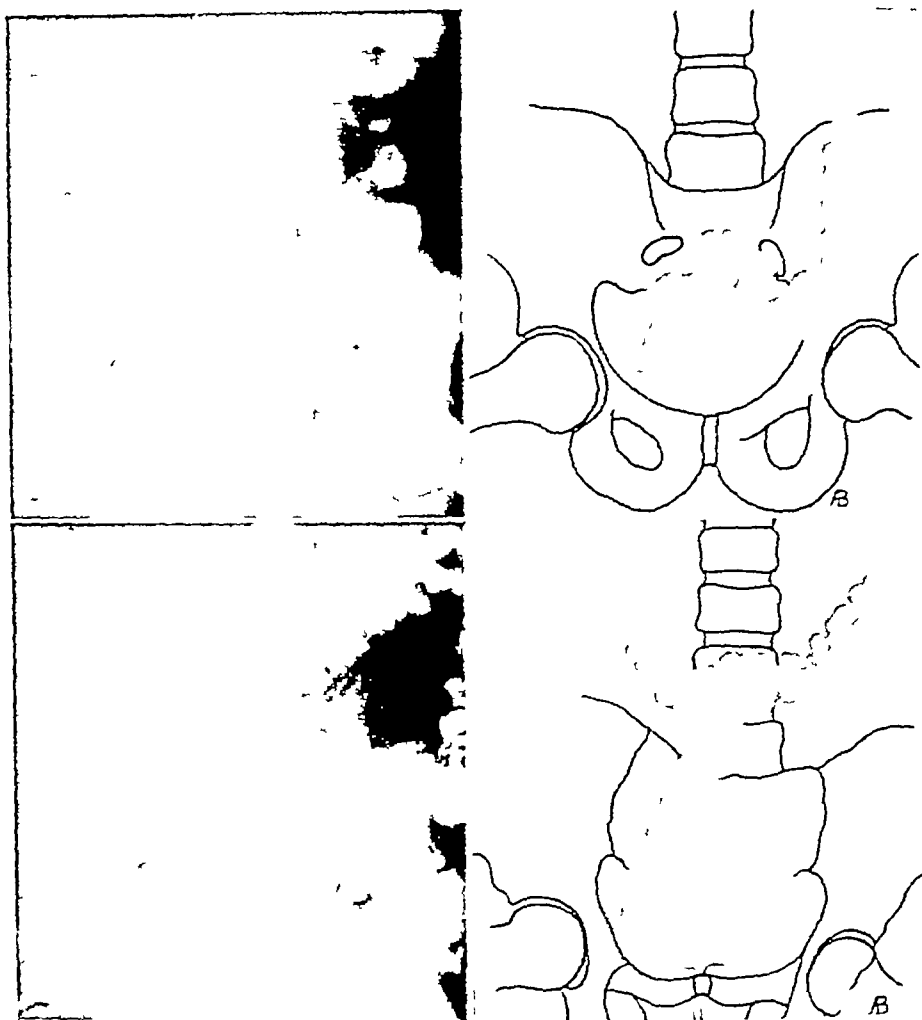
FIG 74 —Vesico-intestinal fistulas *Above left*, communication between a diverticulum of bowel and the bladder, with opaque medium (5 per cent sodium iodide) passing from bladder to sigmoid and up the descending colon, *above right*, sigmoid attached to bladder at site of the fistula. *Below left*, preperforative stage of diverticulum of bowel adherent to the bladder, causing symptoms of cystitis, *below right*, drawing of preperforative stage

VESICO-INTESTINAL FISTULAS.—Almost any sophomore medical student can diagnose correctly vesico-intestinal fistula from the symptoms alone, which are

1 Passing of gas by way of the bladder
2 Passing of urine mixed with feces by rectum
3 Appearance of fecal material in the urine
4 Chronic cystitis, with a foul fecal odor

FIG. 75—Paracystic abscess, originating from osteomyelitis of the ilium, displacing the urinary bladder Suprapubic drainage was required for cure.

The communication may be anywhere between any part of the intestinal tract that overlies the bladder (Fig 74) The appendix and parts of the colon and rectum are most common sites. Acute appendicitis which by inflammatory reaction plasters the appendix to the bladder may favor a communication. Fistulas to the colon are nearly always caused by diverticulitis tuberculosis or a malignant disease. In diverticulitis, the communication may be severed surgically and closed after the acute inflammation has subsided.

VESICOCUTANEOUS FISTULAS.—The commonest type is a suprapubic fistula which persists after operation. We have seen a fistula

which followed the tract of an old osteomyelitic fistula and drained urine through a sinus on the left hip (Fig 75)

The treatment of all these fistulas is surgical

Hernias and Prolapse

There are three types of herniation of the bladder true herniation cystocele and prolapse or herniation through the urethra

True herniation may occur through any of the usual hernia pathways These may be either bladder without peritoneum, the extraperitoneal type, or bladder with peritoneum The bladder in an inguinal hernia is by far the commonest The femoral position is next in frequency The perineal and obturator are rare Ventral hernias generally are incisional hernias

Cystocele occurs in women who have borne many children and have an unrepaired vaginal outlet There is weakness of the vesical fascia and the vaginal muscular wall and fascia It is generally accompanied by rectocele because of the defect in the pelvic floor left by an unrepaired laceration Cystocele is easily diagnosed by inspection

Prolapse of the bladder occurs through a relaxed urethra in the female Fortunately it is rare The bladder may be completely extruded and inverted to the outside Of course this pulls with it the ureters The prolapse must be reduced as soon as possible, a catheter placed in the urethra and the patient put to bed Surgery on the urethra to cure such a condition involves a tightening operation to strengthen the sphincter

The Neurogenic Bladder

This term includes the different types of paralysis of the bladder There are many variations of this disorder In cases of injury involving the spinal cord, retention of urine means that the bladder is paralyzed. If there are complete paralysis of the bladder and total loss of sensation as to the pain of distention and the desire to urinate, one can definitely locate the spinal cord lesion as above the first lumbar vertebra If there is sensation in the bladder and the patient

can empty his bladder, the lesion is at or below the first lumbar segment.

Numerous diseases produce the so-called cord bladder" Among the commonest is neurosyphilis in the form of tabes. Frequently it is "bladder trouble in the form of difficulty of urination, slowness or dribbling that brings the patient to the doctor for relief The fixed or Argyll Robertson pupils, typical gait, loss of knee reflexes ataxia and other typical signs will establish the diagnosis. It must also be remembered that prostatic hypertrophy and stricture of the urethra may be complicating diseases. In any case one must be prepared to differentiate tabetic bladder prostatic obstruction and stricture of the urethra. Other diseases such as pernicious anemia, diabetes in the form of tabes diabetica and infantile paralysis some times affect the bladder

The bladder that has merely lost part of its tone and cannot be properly emptied may present a considerable problem in diagnosis. The hysterical bladder with retention of urine may occur in girls or young women.

Cerebral injuries and brain tumors may have bladder disturbances as part of their symptomatology so that every case of bladder paraly sis calls for a complete investigation. The neurologist as well as the urologist is interested in this problem.

Treatment—In the case of injury to the spine there are three courses of management open (1) let things alone and hope for the development of the automatic bladder; (2) pass a catheter to relieve the retention and leave the catheter in situ, and (3) perform a suprapubic permanent cystostomy The first is usually vain the second is fraught with danger of infection but is somewhat safer now that we have the sulfonamides. The third is the procedure of choice of many eminent urologists

The tabetic type of bladder may improve with treatment of the associated systemic disease, such as tabes, diabetes and pernicious anemia. Management is usually difficult and needs all the expert advice available

Roentgen and Radium Burns

One is apt at first thought to look on roentgen and radium burns of the bladder as avoidable accidents Such, however, is not the case When radium is used to combat a malignant tumor in the uterus or cervix, a large enough dose must be given to kill the tumor. The burns are, therefore, merely annoying trivia, compared with the main issue The ulcers which form in the bladder from such causes heal slowly, if at all The treatment is time and soothing applications to the bladder as outlined for tuberculosis of the bladder earlier in this chapter (p 231)

The Urachus

This dried up remnant of the allantois which extends from the bladder to the umbilicus is not particularly important except for the fact that it occasionally gets into trouble Cysts have been known to form along the course of the urachus near the dome of the bladder A patent urachus allows urine to drip from the umbilicus Whenever a patient, whether a child or an adult, complains of leaking from the umbilicus, complete investigation should be made

Incontinence and Enuresis

In Chapter 1 we discussed enuresis Here we shall outline the management

Incontinence and enuresis are not the same thing and a distinction must be made The child is usually at least 4 years old before the mother pays much attention to his bed-wetting tendency

In incontinence the urine flows from somewhere all the time This can come about from a paralysis of the bladder in which there is either complete relaxation of all the mechanism or spasticity of the sphincter with overflow Congenital valves at the bladder neck or congenital fibrous contractures will produce obstruction with an overflowing, dribbling bladder Ectopic ureteral orifices which may, in the female particularly, be placed in some bizarre position may cause incontinence

When all such conditions are ruled out and the child is found to have no physical defects, we are back to the question of enuresis. Enuresis, or bed wetting, is generally considered a conduct disorder If such a statement is made to a group of mothers at least half of them will be offended. Well trained normal children are never bed wetters. The training of a child really begins the first day of his life. To be sure, emptying the bladder is a reflex act until about the sixth or seventh month. Any time after that, training to control the urinary act should be begun. Daytime training should be emphasized first. By the time the child is 3 years old he should have a dry bed. Children who are well disciplined should have dry beds at the age of 2

Enuresis cases which come to the urologist are the recalcitrant ones. The average child with enuresis should be cured in a few weeks by an intelligent and co-operative mother We are inclined to believe that most mothers never consult a doctor but handle their own problem

Strange things take place in some cases. We have some little patients hospitalized for study for 10 days who never wet the bed while in the hospital The first night at home, however, found a recurrence of the mischief. We have observed a somewhat similar condition when the child goes over to sleep with his little friend in the neighborhood. He never wets the bed on those nights.

We have a case which seems to prove the conduct disorder theory A dentist friend of ours has a boy of 5 who was a bed wetter He liked to sleep with his daddy but his father said he could not sleep with him because of his weakness One night his daddy relented and allowed the child to sleep with him. In the morning the father remarked "Why son, you did not wet the bed." To which the boy replied "No, Daddy I wet my own bed. The child had gotten up gone to wet in his own bed, then returned to his daddy He retained the memory of the act.

The following set of rules for the mother to follow should be put in writing

1 Insist on an afternoon nap All excitement, such as exciting games, horror radio programs, hysterical giggling and laughing among a group of children and any other acts of overenthusiasm should be curbed

2 Flee the psychoanalyst as you would the devil The mother can furnish her own psychotherapy

3 Nervous children may require a sedative, ¼-½ gr of seconal (Lilly) or the bromides in 5 gr doses may be advisable in certain cases The mother should not continue this sedation indefinitely Belladonna or atropine in almost infinitesimal doses sometimes does good

4 Salty foods and candy or sweets should be restricted after 5 00 P M Water intake should also be curtailed after that hour The evening meal should be light and largely devoid of liquids

5 Careful attention must be given to proper nourishment. (Many mothers need to be instructed as to what constitutes proper nourishment of a child)

6 The child should empty the bladder just before being put to bed In three hours he should be put on the toilet and made to empty his bladder again If he wets the bed between that time and morning, he should be awakened and put on the toilet at the end of a second three-hour period

7 The child should not be severely punished or scolded or embarrassed by discussion of his weakness in the presence of adults who laugh The child's co-operation is necessary to a cure

8 A large calendar should be placed where marks in red or other bright colors can be placed on the dry nights and black marks for the wet nights

9 Sometimes moving to a new location where there are new scenes and new schoolmates serves to cure

We have had considerable success in some cases with the Cunningham penile clamp This clamp is placed on the penis before the child goes to bed, when the child feels the urge to urinate, the blocking by the clamp will cause enough pain to awaken him

Diseases of the Prostate and

Seminal Vesicles

THE FUNCTION and physiology of the prostate is better understood now than formerly The prostate is a sexual organ although not very important. One of its functions is the elaboration and secretion of a milky fluid which forms the bulk of the seminal discharge. Recent experimental work on dogs has shown that the seminal or prostatic fluid is secreted continuously by the prostate This fluid is alkaline with pH varying from a little less than 7 0 to almost 8 0

The prostate can be surgically removed without in the least disturbing sex function. This is not the case when radical operations are done for cancer in which the entire prostate, prostatic urethra, parts of the seminal vesicles and bladder neck are removed. In such cases the patients are thereafter both sterile and impotent.

Injuries

The deep protected position of the organ shields it from all but the most unusual injuries. Puncture wounds by sharp objects have been reported and bullet wounds sometimes involve the prostate

The most important injuries are inflicted by inept attempts at catheterization with a metal catheter Bungling attempts to pass a cystoscope or a sound may have the same untoward effect. By these misguided efforts false passages may be made through the gland.

It is fortunate indeed if such a false passage leads back into the bladder and not the prevesical or perivesical space or rectum

Prostatitis

The general term "prostatitis" includes all the infections of the prostate as well as inflammations that accompany prostatic obstructions By nonspecific prostatitis is meant an infection of the prostate caused by any of a large variety of bacteria The commonest invaders are Bacillus coli and the various forms of streptococcus, staphylococcus and pneumococcus

ACUTE NONSPECIFIC PROSTATITIS —Since prostatitis is as common in the male as cystitis is in the female, it is well to review the symptoms of acute prostatitis The subacute and chronic forms have somewhat modified symptoms

Symptoms—The symptoms of the acute form are (1) frequency of urination with burning and pain, (2) nocturia, (3) pain in urethra, rectum, perineum, back, etc, (4) blood in the urine, (5) urethral discharge, (6) fever, (7) chills, (8) prostration Not all of these are present in a given case at one time

Usually the onset is sudden Often it is ushered in with a chill which may be severe and prolonged, followed by a sharp rise in temperature to 103 to 105 F A discharge from the urethra may appear, and only a clear conscience will prevent the patient from experiencing a bad fright Many a case of acute prostatitis has been misdiagnosed acute gonorrhea solely on the basis of discharge from the urethra Frequency of urination is a distressing symptom It is usually preceded by a deep burning pain that causes an urgent desire to void The pain is deep in the perineum or around or in the rectum Sometimes the pain is in the back, low in the sacral region Sometimes there is annoying spasm of the urethra itself The nocturia may be as frequent as every half-hour Smears from the discharge may show no organisms, only polymorphonuclear leukocytes

Blood in the urine usually frightens the patient. It is seldom bright red, but usually dark brick-red and thick It commonly appears in the first portion of urine that is passed with that following, clear

Diagnosis —The diagnosis is suspected from the character of the symptoms. The urine is examined by the two-glass method (p 14) The physician should next examine the prostate The palpating finger in the rectum will encounter a large, smooth rather firm and exquisitely tender prostate. This completes the diagnosis.

Treatment —In acute prostatitis, both penicillin and the sulfonamides work magic. A total of 200 000 to 300 000 units of penicillin generally cures the patient in 48 hours

SUBACUTE NONSPECIFIC PROSTATITIS.—The symptoms are less severe than those of acute prostatitis and all may not be present. The examining finger in the rectum encounters a prostate that is boggy and full. It does not have the exquisite tenderness of the acute form. The secretion obtained by the method shown in Figure 76 (p 257) may appear as pure pus and may be tinged with blood.

CHRONIC NONSPECIFIC PROSTATITIS.—Chronic prostatitis is the commonest form and is frequently found with chronic pyelitis. The patient with chronic pyelitis almost always has chronic prostatitis However the reverse is much less common except as a coincidence.

Nonspecific prostatitis is probably seldom caused by sexual contact. On the contrary lack of regular sex activity in one accustomed to it may induce prostatitis. We have seen it often in the husband whose wife is pregnant. After four or five months of abstinence the patient comes with symptoms of prostatitis Massage of the prostate shows the prostatic secretion loaded with pus. Massage in this instance affords great relief When regular sex relations are again instituted the patient is cured. The same situation occurs when a young married man is inducted into the Army or Navy In the Army it is called the Navy Disease and in the Navy the Army disease The reason for this condition is simple enough. The secretion in the little lobules of the prostate acts as culture medium for the invading bacteria which usually arrive by way of the blood stream.

Treatment of Nonspecific Prostatitis —We have found the following routine satisfactory

1 The patient with an acute case is put to bed.

2 A capsule containing ½ gr codeine and 3 gr acetylsalicylic acid is given as needed for pain and discomfort

3 For the accompanying nervousness, a capsule of 1½ gr seconal is given as needed, but at no stated time

4 In certain cases penicillin is of value, but in the majority of cases it has little or no effect When given, doses up to 200,000 or 300,000 units should be administered over a 48 hour period. The sulfonamides are useful Sulfadiazine, sulfathiazole or sulfacetimide, or combinations of these, can be given in doses of 15 gr four times a day for four day periods with rests between courses It is well to remember that about 15 per cent of patients are sensitized to sulfathiazole and consequently to all sulfonamides These reactions are discussed more fully in Chapter 20

In patients who cannot take the sulfonamides or antibiotics, a regime we have used for years is always effective in reducing the acutely inflamed prostate and lowering the fever

1 The first, third and fifth days, 5 cc of either aolan or proteolac is injected deep in the muscles of the buttocks with a long needle

2 The second, fourth and sixth days, 15½ gr sodium iodide in a 5 cc ampule is injected intravenously

Heat may be applied to the prostate by continuous irrigation of hot water through a special prostatic heater or by a thermostatically controlled electric prostatic heater The aolan-sodium iodide treatment is more effective, however

Prostatic massage should not be started until the fever has subsided and the prostate reduced in size (Figs 76 and 77) This takes 10 days to two weeks Even then, massage should be very gentle It should not be carried out oftener than twice a week.

Cure of subacute and chronic prostatitis is often difficult Focal infections in teeth, tonsils, sinuses or elsewhere should be sought and eradicated. They are not always a factor, but may be important.

Vaccines have been tried without success Various surgical procedures for injecting medications into the prostate under the capsule have not been uniformly satisfactory
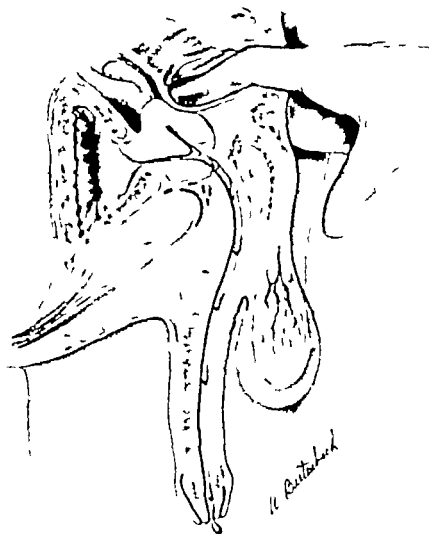
FIG. 76.—Method of prostatic massage for both diagnosis and treatment. We always (1) put the patient on the table in knee-chest position (2) cleanse the meatus with an alcohol sponge (3) have the patient hold a sterile medicine glass under the meatus to collect fluid (4) examine the fluid microscopically

Resection of most of the prostate, even in a young man, is justified in cases of intractable chronic prostatitis

GONORRHEAL PROSTATITIS —This disease is an accompaniment of acute gonorrhea Sometimes it appears within a few days of the initial discharge and then is violently fulminating and may result in a prostatic abscess All the symptoms of acute prostatitis are seen here Fortunately this disease is less common since the advent of the

A   B

FIG 77 —Diagrams of prostate and seminal vesicles indicating proper method of prostatic massage A strokes of the gloved finger follow the numbered lines, beginning at 1, 2 and 3, moving to 4, 5 and 6, from the outer portion of the prostate toward the center, finishing on 7 and 8 B, four or five strokes are then made in the direction of the arrows, making a total of 30 to 40 strokes

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TUBERCULOUS PROSTATITIS —This is always secondary to genital tuberculosis and probably is an extension of tuberculosis of the seminal vesicles We have never seen a case of tuberculosis of the prostate that was not accompanied by tuberculosis of the seminal vesicles and epididymis Treatment is the same as for tuberculosis of the genital tract

PROSTATIC ABSCESS —In recent years this has become a rare disease Formerly it regularly accompanied severe acute gonorrhea.

The sulfonamide and penicillin treatment of gonorrhea has almost caused its disappearance

Acute prostatitis from any cause may result in a prostatic abscess. Indeed in many cases of acute prostatitis multiple small abscesses are formed in the smaller lobules These either rupture to the outside via the ducts or coalesce to form larger abscesses which are still only a few millimeters in diameter

Most prostatic abscesses rupture into the urethra through the prostatic ducts. Sometimes the abscess becomes huge and bulges into the perineum. Large prostatic abscesses are often accompanied by abscesses in the seminal vesicles. These abscesses were formerly called male pus tubes

Prostatic Obstruction

Prostatism is the term used to describe a definite syndrome which is the result of obstruction at the vesical neck. This obstruction may be due to various prostatic pathologic processes including benign and malignant hypertrophy contractures, valve formations and median bars. Prostatism is not confined to the aging male. It is seen in young boys with vesical neck obstruction.

The syndrome consists of (1) difficulty and slowness in urination, (2) frequency particularly at night (3) general malaise due to abnormal increase of nitrogenous waste in the blood (4) changes in the bladder and kidneys due to increased hydrostatic pressure, so-called "back pressure" (5) increase in blood pressure to overcome the back pressure in the urinary tract. If infection enters the urinary tract, more complications arise, including pyelitis, pyelonephritis and cystitis. One or all of these may be present. The prostate itself may become infected and periprostatitis set up

The patient passes through the various stages of increased frequency of urination, slowness, difficulty and nocturia. All this time the bladder wall is strong and thick and the bladder detrusor muscle will force the urine through the obstructed vesical neck. The stage of residual urine is reached after months or even years of the foregoing

conditions Residual urine means that amount which is left in the bladder after the patient has made his best efforts to empty the bladder and really believes he has emptied it Once residual urine is established, the volume increases The bladder muscle becomes less efficient, and the bladder wall becomes thinned and weak The stage is set for the final phase, complete retention No attempt should be made to find out the exact amount of residual urine unless the patient is hospitalized, the dangers far outweigh the information obtained

Prostatic Hypertrophy

Some prefer to call this obstructive lesion enlargement of the prostate or benign adenomatous hypertrophy or to use other descriptive terms

ETIOLOGY —About 30 per cent of men who reach the age of 50 have some degree of prostatic hypertrophy At the age of 60 this percentage is increased, and it increases with every decade thereafter Of the 30 per cent group of potential "prostatics," 20 per cent will develop malignant disease of the prostate Formerly it was thought that hypertrophy of the prostate was a disease of married men, but it exists in the married and single alike Apparently infection, inflammation and irritation have no rôle in prostatic hypertrophy

Our present ideas concerning the etiology of prostatic hypertrophy have been somewhat crystallized by the work of Randall, Lower and Johnston and their associates, Deming and Jenkins, P E Smith, and others The pituitary gland apparently is responsible for the normal functioning of the gonads, in turn, the testes are necessary for maintenance of the normal prostate Randall showed that prostatic hypertrophy arises essentially from the prostatic urethra The work of White of Philadelphia in the 1890's cast confusion on the whole problem for many decades, for White and many of his contemporaries claimed absolute cure of prostatic hypertrophy in elderly men by castration Experimental castration

of monkeys by Deming and Jenkins showed that, although the prostate became atrophied, no change occurred in the mucosa of the prostatic urethra. These experiments proved that castration caused atrophy of the normal prostatic tissue but had no effect on the hypertrophic changes which changes Randall showed arise from the subepithelial glands of the prostatic urethra. Those who are castrated before puberty apparently always have atrophic prostates. Those who are made eunuchs after puberty develop prostatic hypertrophy in apparently the same percentage as the rest of the male population. Prostatic hypertrophy because of its origin in the urethral submucosal glands, is not favorably affected by estrogenic substances commonly in use.

PATHOLOGY — With prostatic hypertrophy there are formed in the prostate small rounded bodies called spheroids. These consist of isolated groups of hyperplasia and stand out distinctly from the normal prostatic tissue. These groups grow in size and number gradually replacing and crowding aside practically all the normal prostatic tissue. The prostate thus hypertrophied presses against the prostatic urethra, elongates it, bulges into the rectum and herniates up into the bladder.

The normal lobular form is accentuated by this process so that generally three lobes are recognized, one middle and two lateral. Often, only one lobe undergoes hypertrophic changes and we then have obstruction by a valve-type of mechanism due to a middle or lateral lobe. Sometimes the obstructing prostate takes the form of a fibrous mass not characterized by spheroid formation.

The vesical neck contractures are also fibrous but are usually in the form of circular contracting bands. Contractures in boy babies are rare but nonetheless real. They cause prostatism. Congenital valves in the posterior urethra may have done irreparable damage by the time they are discovered.

Treatment of Prostatism and Prostatic Hypertrophy

Relief of the obstruction at the bladder neck is the goal of all

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Treatment of Prostatism and Prostatic Hypertrophy

Relief of the obstruction at the bladder neck is the goal of all

treatment of the prostatic patient How this is to be accomplished and what steps are necessary, both in preliminary and in postoperative care, are discussed here

The neglected prostatic patient who has allowed himself the luxury of complete retention offers an immediate medical problem Usually, the first step is catheterization If the patient has not voided for 24 to 48 hours and the bladder is enormously distended, it is wise to take off the urine slowly and in stages In other words, decompression should be done

When the retention has been relieved it is best to leave an indwelling catheter in the urethra for permanent drainage The problem of general medical complications is then dealt with

The patient's system may be much depleted The hemoglobin content may be depressed The urine may be infected, owing to pyelonephritis or to the prostate itself The bladder may be infected, and there may be complicating diseases such as diverticula or stones in the bladder

It is necessary to treat such a patient with rest in bed, continuous drainage by an indwelling urethral catheter and administration of sulfacetimide or sulfathiazole, $7\frac{1}{2}$ gr three times a day after meals, for the infection If the hemoglobin content is too low, a sulfonamide should not be given and one must depend on increased water intake alone Diet should be ample but well balanced Many patients have marked increase in blood pressure With catheter drainage and rest, all but a few improve greatly and the blood pressure is lowered. An electrocardiographic study should be made, since impairment of the heart is often part of the picture

When careful treatment is shown by examination to have put the patient in as good physical condition as possible, the next step is operation to eliminate the prostatic obstruction or hypertrophy Operation is still the only satisfactory cure for the hypertrophic obstructing prostate There are two methods

1 *Open Surgical Method* —The suprapubic surgical approach to the hypertrophied prostate is the usual operation If careful aseptic
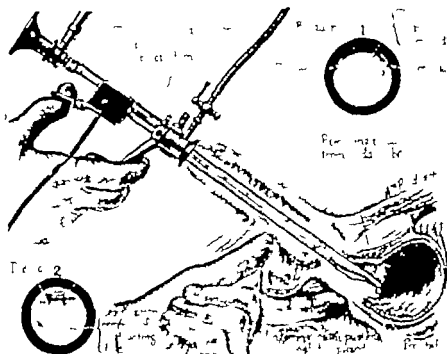
Fig. 78.—Prostatic resection with the Nesbit modification of the Stern-McCarthy electrotome. (This and Figs. 79 and 80 courtesy of the American Cystoscope Makers, Inc.)

Fig. 79.—The loop.

CUTTING LOOP   BAKELITE SHEATH
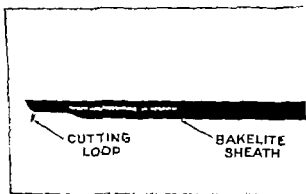
Fig. 80.—The high frequency loop and bakelite sheath.

technic is used and a two-stage operation done, mortality is low and the results are excellent The frequent use of the two-stage operation suggests an appreciation of the dangers involved

The perineal approach has much to recommend it in skilful hands The period of convalescence is shorter than after the suprapubic operation However, a certain number of patients will fail to regain complete sphincter control following perineal operation, no matter how skilfully it is done The advantage of the open surgical over the closed or resection methods has been that all of the prostate could be removed by open surgery whereas only partial removal could be done by the transurethral methods

2 *Transurethral Prostatic Operations* —There are two transurethral operations, the cold tubular knife or punch method, and the high frequency loop method (Figs 78, 79 and 80) Both are more difficult than open surgery In skilled hands practically all of the hypertrophied gland can be removed The size of the gland offers some guide as to which operation, open or transurethral, should be done When the gland probably weighs as much as 150 Gm , suprapubic prostatectomy should be the operation of choice Many elderly feeble patients who could not survive an open surgical operation can be operated on by a transurethral method with happy results The transurethral approach has extended the operative relief from prostatism to many formerly inoperable patients

Prostatic Calculi

These concretions are not similar to renal, urethral and bladder stones Studies have shown they are more akin to the stones that sometimes develop in the salivary glands They usually form in the fourth decade of life and any time thereafter In those nearer 40, the stones are not associated with prostatic hypertrophy, but in older patients the association is nearly always present In most cases the calculi are found in the prostate itself

Sometimes one can feel the crepitation of the stones on rectal examination of the prostate They are easily found in a roentgeno-

gram if care is taken to get correct position. Many patients are treated for years for chronic prostatitis without the calculi being discovered.

The symptoms are those of prostatic enlargement or prostatitis. In a large percentage of cases there is an associated infection

A skilful operator can remove these prostatic calculi with the resectoscope The perineal operation is sometimes necessary It provides better drainage which is important in some cases.

The Seminal Vesicles

The seminal vesicles are among the paired organs of the body They are in reality the expanded ends of the vasa deferentia. The most important disease which attacked the seminal vesicles was gonorrhea. Now that this disease has been brought under control by the sulfonamides and antibiotics we no longer see the virulent type of seminal vesiculitis which formerly was a frequent complication of a gonococcic urethritis

As has been mentioned this disease caused so much trouble as to be designated male pus tubes Seminal vesiculectomy was a mutilating operation When it was popular two decades ago it was often performed on young men The result was often failure to cure the systemic symptoms the condition was supposed to be causing, and the price paid by the patient for local relief was complete impotency and sterility

Cancer of the seminal vesicles is so rare that it needs little consideration here. The diagnosis would be extremely difficult, in any case. When cancer of the prostate has progressed beyond the early stages, extension to the seminal vesicles is nearly always found.

Stone in the seminal vesicles is rare and seldom discovered except at autopsy

There are some *anomalies* of the seminal vesicles such as absence on one side or of one of the pair As stated in Chapter 10 the ureter occasionally opens into the seminal vesicle The anomalies are also rare and generally only discovered at autopsy

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Carcinoma of the Prostate

UNTIL RECENTLY carcinoma of the prostate constituted one of the darkest chapters in all of surgery Among men who, from long experience, were most familiar with the disease, pessimism prevailed The reason for this pessimism was fourfold (1) there are no early symptoms, (2) early metastasis to the bones of the pelvis, lumbar vertebrae, sacrum and femur is the rule in about half the cases, (3) despite the statements of "radioactive" enthusiasts, there are practically no radiosensitive prostatic cancers, and (4) whatever was done seemed to be of no avail

The fact that there are no early symptoms is baffling, for a patient "who is whole has no need of a physician" Only in patients who come with totally unrelated complaints and are given a routine examination, including a rectal examination, is early cancer of the prostate discovered Far too often the patient comes because of "rheumatism in his bones" Examination of the prostate reveals the horrible truth—a well advanced, inoperable carcinoma X-rays of bones show wide dissemination of the carcinoma, unmistakable in its characteristics, the cause of the supposed "rheumatism"

Probably the largest group comes to the urologist because of "prostate trouble" In many cases, it is simple hypertrophy, but in about 20 per cent the diagnosis of carcinoma of the prostate is all too apparent

The surgeon who had large experience in cancer of the prostate became a pessimist He soon realized that in about 40 per cent of

the cases, bony metastases had already taken place. Study of these patients with bone metastases showed that the time from discovery of the bone lesions to death was about 10 months. This was the fate of two of every five patients. Three of every five patients had a chance to live as long as 10 years. But what years of suffering they were! Most doctors preferred not to tell the unfortunate one the real truth. The reason for this was principally to spare the victim the added torture of mental worry over his condition. The doctor must confide the truth to some responsible member of the family but this was often unsatisfactory and led eventually to misunderstanding and dissatisfaction. The dissatisfied patient became the unhappy victim of the cancer quack. If the doctor elected to tell the patient the truth, the patient frequently reacted badly Not infrequently he ended his life, but more often he listened to the lure of the quack who promised so much but could do so little.

In 1858 Sir Henry Thompson of London wrote a treatise entitled *The Enlarged Prostate* and in chapter 10 described and discussed "Malignant Disease of the Prostate. He quoted the statistics of M. Tanchou, who made an abstract of the registers of death for Paris for the years 1830-1840 In this 10 year period there were, according to Tanchou, 8,289 deaths due to cancer—1,904 in males. In this group Tanchou found only five cases of primary carcinoma of the prostate. These statistics, Thompson said, were commonly cited at the time he wrote his book for that matter they are not infrequently cited today

Thompson went on to state that malignant disease of the prostate was undoubtedly rare. However he believed that this rarity was only apparent and not real. He reported 12 cases of malignant disease of the prostate A review of his table of these 12 cases indicates that 10 and possibly 11 were sarcomas of the prostate and only one or two were actually carcinomas We make this deduction from the fact that he called them encephaloid," a term that was applied to tumors that are soft and brainlike and the only cancer of the prostate that is soft and brainlike is the sarcoma.

It was not until the beginning of the twentieth century that medical men began to be aware of the frequency of prostatic cancer In the United States, Hugh Young stated in 1905 that he had seen 250 cases of benign prostatic hypertrophy and 68 cases of carcinoma of the prostate. This was an incidence of 21 per cent Although this was a startling statement at that time, it has been abundantly proved to be true in many large series We have come to believe that about 20 per cent of all prostatic hypertrophies are malignant

SYMPTOMS —The symptoms are, when present, the same as those of prostatic hypertrophy described in Chapter 14 In 8 to 10 per cent of cases of carcinoma of the prostate there are no symptoms referable to the urinary tract These insidious cases are the most frustrating of all because the tiny nodule in the prostate is not large enough to produce obstructive symptoms Sometimes metastasis to the bone or, on rare occasions, to the lungs causes the illness that brings the patient to the doctor We have seen several cases of bladder paralysis due to extensive involvement of the spinal column by metastasis from a tiny nodule in the prostate This has caused Colston to state that not over 4 or 5 per cent of patients with carcinoma of the prostate are suitable for radical perineal operation Lowsley states that in less than 5 per cent is the disease discovered early enough to warrant an operation for radical cure These apparently innocuous nodules in the prostate all metastasize early so that by the time the disease is diagnosed nothing can be done

It has been taught that prostatic cancer always begins in the posterior lobe, but our experience proves that is not true The earliest lesions we have seen have been in a lateral lobe, the middle or posterior lobe being unaffected The malignant nodule may develop in the middle of a benign prostatic hypertrophy and apparently soon spread to every part of the gland We have had about 12 cases in which a benign hypertrophied prostate was removed by suprapubic enucleation and in a period varying from eight to 25 years carcinoma developed in the old prostatic bed

Hematuria is generally rated as an important sign in malignant

disease of the urinary tract. In carcinoma of the prostate it is only a late symptom and then not as common as in benign prostatic hypertrophy

TREATMENT —Until recently the treatment of carcinoma of the prostate took the following form (1) If prostatism occurred, the prostate was resected or an indwelling catheter was placed for more or less permanent drainage. Sometimes permanent suprapubic cystostomy was advocated, but this has not been used much in recent years. (2) When bony metastases were discovered and the patient suffered pain, roentgen therapy was given to the bones with sometimes temporary relief (3) Various forms of palliation were used, principally with the idea of relieving pain.

In our series of cases, the patients who had bony metastases lived an average of 10 months after discovery of the bony lesions. Studies of a large series of autopsies on old men revealed that the older the men, the higher the percentage of prostatic cancer

In 1893 J W White of Philadelphia advocated castration for the relief of prostatic hypertrophy White and many of his contemporaries claimed uniformly good results from this procedure Careful study of their work reveals that there was a high mortality (20 per cent) for this minor operation, even in the best hands. How many thousands of testes were thus sacrificed on the altar of hope will never be known. More recent scientific investigation indicates that the removal of the gonads could not be the final answer to the problem. In 1894, Fuller of New York began to do suprapubic prostatectomies. Ramon Guiteras, also of New York, was another pioneer in this work. By the year 1900 enthusiasm for orchidectomy had begun to wane, and well-considered surgery was getting a start.

Cancer of the prostate was another story The best we could offer the prostatic cancer patient was that he be seen early and have a radical operation for removal of his prostate—cancer and all. This offered him at best less than a 50 per cent chance of cure with permanent sexual impotency and sterility

Investigations of presence in the urine of considerable quantities of acid phosphatase led to the discovery that the source was in the prostate Normal adult prostatic tissue was found to be rich in acid phosphatase There were found to be two distinct phosphatases, the acid, which had a pH of 4 9 to 5 0, and the alkaline, which had a pH of 9.3 After much more investigation it was discovered that the men with prostatic cancer had a high blood content of acid phosphatase whereas women had only about 20 per cent of that found normally in the male

In 1934, King and Armstrong devised a method of determining the amount of phosphatase in blood serum The standard, or unit, is therefore known as the King and Armstrong unit Normal values were determined after many trials The accepted upper limits for acid blood phosphatase is around 4 0 King and Armstrong units and for alkaline blood phosphatase around 8 0 King and Armstrong units It was soon found that many patients with prostatic carcinoma had a higher blood content of acid phosphatase than normal When bony metastases could be demonstrated by roentgen study, there was also a higher than normal alkaline serum phosphatase Experimental evidence showed that if a patient with cancer of the prostate was given an androgen (male sex hormone) or androgenic substance such as testosterone propionate, he was definitely made worse and the phosphatase level rose If, on the other hand, he was given an estrogenic substance such as theelin or stilbestrol, he felt better and the phosphatase levels tended to fall toward normal These, with other known facts, definitely established carcinoma of the prostate as an endocrine problem

Huggins and his associates at the University of Chicago then studied 21 cases of cancer of the prostate and obtained more interesting information It was found that if stilbestrol were given in doses of 1 mg per day, the acid serum phosphatase steadily fell and certain changes took place in the patient, including changes in the breasts, approximating the female contour, decrease in libido, improvement in general condition, and recession of the prostatic cancer

After this study there could be no doubt that there was a relation ship between the androgenic hormones and cancer of the prostate

Much improvement therefore could be had by administering the estrogenic substance in 0 5 to 1 0 mg. doses per day to neutralize the excess of androgen. The principal sources of androgenic substances in the body are supposed to be the gonads, under the control of the pituitary and, to a lesser degree the adrenals.

The work of White and his contemporaries in the 1890 s and their claim of strikingly good results in reducing prostatic hypertrophy by castration seemed to Huggins of Chicago to justify its trial in cancer of the prostate. Removal of the testes, it was thought, would cut off the body source of androgens. Huggins was cautious in his statements of results, but he was soon able to show that in most cases there were (1) a marked improvement in general health (2) a marked recession in size of the obstructing prostate with consequent relief of difficulty in urination (3) in cases of bone metastasis, a steady regression of the disease In the several years since Huggins work, emulated by a host of urologists and general surgeons, who knows how many more thousands of gonads were sacrificed. Experience has shown that results of castration for carcinoma of the prostate are by no means uniform. No rules have, as yet, been formulated by which one may with certainty select cases for orchidectomy Perhaps the one definite clinical picture in which castration is indicated is that of a stony hard prostate proved by biopsy to be cancer with bone metastases (passed on by a competent urologist or roentgenologist) and pain arising from the bone metastases. Relief from the pain is immediate and dramatic. In some cases the beneficial results remain for a long time in others, the course of the disease is only temporarily halted.

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with perhaps some reason in our experience, that unless each testis weighs 20 Gm or more, a good result will not be obtained by castration

Castration is not the final answer to the problem of prostatic cancer In general, when a patient with prostatic carcinoma has prostatic obstruction, management should be as in benign prostatic hypertrophy That is, relief of the urinary obstruction should be by transurethral resection, and orchidectomy should not be done Later, as the disease progresses, and at the proper time, castration may be done

The lot of the prostatic cancer patient has been slightly improved He lives longer by many months and he can be made more comfortable because he can be relieved of the racking pain of bone metastases The new day is not yet here

Diseases of the External
Male Genitalia

THE VARIOUS venereal diseases involving the male genitalia probably deserve first consideration in a discussion of these organs.

Syphilis

Any physician should be able to recognize the primary sore of syphilis. The so-called hunterian chancre takes many forms (Fig. 81) It may be a flat, innocent appearing lesion. It may take the form of a pimple or papule with a clear top filled with fluid. It may be masked by accompanying infection. It may be a sore covered with a crust and surrounded by induration. Therefore any sore on the penis should be suspected of being a primary syphilitic lesion if the patient is also anxious about the possibility

It must be remembered in this connection that the incubation period of syphilis is 10-42 days When more than a month can pass from the time of the suspicious contact to the appearance of the local lesion, the patient may not remember clearly all the details as to the time of exposure.

If the patient comes to the doctor when the lesion first appears, diagnosis by dark field examination may be simple and conclusive. But if he waits until the lesion is a week to 10 days old, other signs are present which the doctor must recognize. The character of the lesion may have changed considerably in that time. At first, one
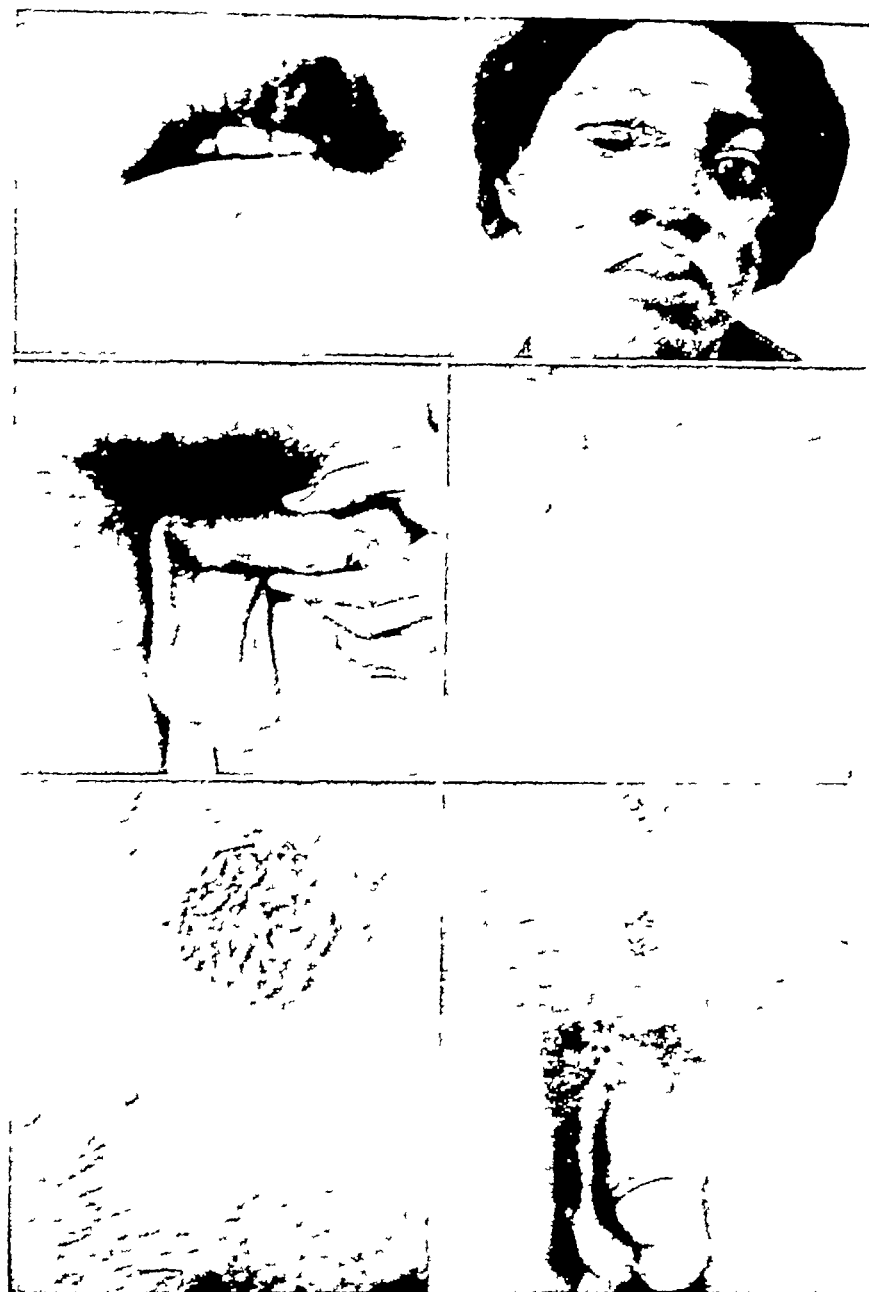
FIG 81 —Syphilitic chancres *Top left,* on lip of candy dipper *Top right,* of eyelid after using friend's urine for eye drops *Center left,* typical. *Center right,* anal (a gentleman gave him a dollar) *Bottom left,* on breast, where woman bit him. *Bottom right,* rare double primary on abdominal wall.

inguinal chain of lymph glands becomes enlarged, while the other side remains unaffected. This is highly significant. By this time, the blood Wassermann reaction is positive, so by all means a blood test should be done. The Wassermann reaction becomes weakly positive in about 10 days and is strongly positive in 18 to 20 days. Once a positive reaction is obtained and other signs are present, the diagnosis is clear

TREATMENT—The use of penicillin has greatly shortened the period of treatment. It is too early to say how permanent these results will be compared with the older and slower method of arsenical and bismuth therapy Until the many cases treated with penicillin alone are adequately followed up and the results determined, we prefer to follow the course of penicillin with arsenicals and bismuth. In the treatment of syphilis, 40 000 units of penicillin should be injected intramuscularly every three hours for 7½ days or a total of 2 400 000 units Small chancres are usually healed by the time the course is finished however large lesions may not be entirely healed although dark field examinations will be negative. The serology becomes negative between the second and fourth month after treatment. Quantitative serologic studies should be used in following up syphilitic cases treated with penicillin. Recent studies indicate that combined therapy using both penicillin and arsenical and bismuth therapy gives the best results.

Relapses under penicillin therapy usually occur in the third or fourth month and may be manifested by the appearance of syphilitic lesions of the mouth, genitals and skin. Dark field examinations frequently become positive and the titer of the quantitative serologic tests will show a progressive rise if checked at weekly intervals. A second course of penicillin should then be administered, giving 50 000 units every four hours for a total of 4 000 000 units. Relapses should certainly be treated by arsenicals and bismuth as well as by penicillin. Neoarsphenamine intravenously in 0 3 to 0 45 Gm. doses once a week, together with bismuth intramuscularly is standard treatment. We feel that continuous treat

ment for at least two years in such cases, or until the blood and the spinal fluid Wassermann reactions become permanently negative, is the best possible type of management. Judgment is required as to when a spinal puncture should be done, some advocating early and some late puncture Mapharsen is excellent as an alternative of neoarsphenamine We prefer oil- to water-soluble bismuth preparations

Early diagnosis is extremely important If one bases the diagnosis on the finding of spirochetes by the dark-field method, the Wassermann reaction being negative, the chances for cure are greatly enhanced We have had four cases with second chancre and one with third A patient who already has syphilis cannot acquire a primary lesion a second time If, however, he is cured of syphilis he may become infected a second time and have a primary lesion Such proof of cure may be merely of academic interest, but it proves that syphilis definitely can be completely cured

PROPHYLAXIS AGAINST SYPHILIS —The use of the condom is effective against syphilis as far as a part of the penis is concerned Regardless of whether such protection is used, a thorough cleansing or sterilization of the unprotected parts should follow The older physicians said of the condom "a cobweb against infection, a cuirass against pleasure" For that reason, cobweb though it is, its use is often neglected

The man should, within 20 to 30 minutes of exposure, go through the following ritual

1 Wash the parts thoroughly with soap and water, in a shower bath or tub if possible

2 Dry the parts thoroughly and apply alcohol locally and again dry

3 Apply some form of mercury ointment, rubbing it in thoroughly, 10 per cent ammoniated mercury ointment will do The regular blue ointment is obnoxious because it looks dirty and stains Fifty per cent calomel ointment is effective and also clean, this should be left on 12-24 hours

Volumes have been written about syphilis and some of these should be a part of every physician's library We have only sketched a plan of treatment here. Penicillin, in doses used in gonorrhea, may delay the appearance of a chancre, may mask the disease or may prevent it entirely

Chancroid

Chancroid is a venereal disease thought to be due to the bacillus of Ducrey (Augusto Ducrey, Italian physician 1860) Formerly the free clinics abounded with cases of this destructive disease. The incubation period is much shorter than that of syphilis, being from three to five days It is extremely difficult and dangerous to pronounce a penile lesion as being a "soft chancre" or chancroid, for it may harbor the syphilitic spirochetes as well

A chancroid has no features or characteristics distinguishing it from a primary syphilitic sore. It is not uncommon for a small lesion on the penis to be the direct cause of inguinal adenitis which may become a suppurating bubo It will break and discharge pus if let alone, then take a long time to heal

There is no use looking for the bacillus of Ducrey for it is doubt ful that this organism is really the cause

TREATMENT—Sulfathiazole treatment supersedes all other forms of management. It is given in an initial dose of 45 gr., followed by 15 gr four times a day for a week, or until the lesion heals. Sulfathiazole powder should be applied to the sore

Granuloma Inguinale

This disease occurs much more frequently in Negroes than in white people In fact most cases in white persons can be traced to contact with Negroes.

SYMPTOMS AND DIAGNOSIS—Granuloma inguinale usually begins on the shaft of the penis as a small papule which rapidly breaks down to form a progressively ulcerative lesion. As the lesion advances, the old ulcerated area heals by forming dense scar tissue.

FIG 82—Destructive effects of granuloma inguinale *Above,* lesion encircling the penis just behind the corona, threatening blood supply to the glans *Below,* untreated cases in which penis was lost.

The ulcerative processes are highly destructive to the genitalia and the deformities produced by contraction of the scar tissue are considerable (Fig 82) The ulcers are not painful or sensitive to touch as long as they are small later when they become secondarily infected, they may become painful. After many years the disease runs its course but the deformities remain. Extension to the scrotum and perineum is the rule in neglected cases.

In the early stages the disease may be confused with syphilis or chancroid, but it is most often confused with lymphopathia venereum.

The diagnosis can be substantiated by finding Donovan's bodies on staining a section with Wright's stain. The Donovan body is a gram-negative, nonmotile encapsulated bacillus.

TREATMENT —The disease can be cured by the intravenous administration of fuadin or potassium and antimony tartrate The earlier the treatment is begun, the less the deformity Fuadin is the drug of choice since it produces less constitutional reaction than any other preparation. It is administered in 5 cc. doses daily intravenously or intramuscularly for 10 days If reactions occur the drug may be given every other day

Lymphopathia Venereum

This disease is also known as lymphogranuloma inguinale Like granuloma inguinale, it is seen chiefly in Negroes. In the United States it is common in the South, less common along the eastern and western seaboards and extremely rare in the north central section, even among Negroes. It is probably due to a filtrable virus.

SYMPTOMS AND DIAGNOSIS.—Lymphopathia venereum is a disease of the lymphatic system of the external genitalia (Fig 83) It begins from six to 60 days after exposure as a pinhead-sized, painless erosive lesion on the glans, foreskin and urethra. This lasts for 10 days and is followed by enlargement of the inguinal lymph nodes which rapidly break down with formation of draining sinuses. There are considerable rise in temperature headache malaise and

slight leukocytosis In the male, the draining sinuses persist for years and there are marked scarring and fibrosis Finally the lesion heals, in two to 20 years Extension in the male to the perirectal lymphatics, with formation of rectal stricture, may also occur Usually the stricture is low in the rectum, although high rectal strictures may be formed

Lymphopathia venereum also ˉaffects the female Since the

FIG 83 —Lymphopathia venereum, also called lymphogranuloma inguinale, poradenitis nostras, Frei s disease, Nicholas-Favre's disease, pudendal ulcer and climatic or tropical bubo

primary lesion is on the cervix it is frequently overlooked The disease spreads to the deep pelvic lymphatics and seldom affects the superficial inguinal lymphatic chain Perirectal and perivesical abscesses are common Rectal strictures are formed as a result of scar tissue contraction, and vesicovaginal fistulas may result from ulceration

Diagnosis of lymphopathia venereum can be verified by the intradermal Frei test (Lederle). The test is positive when a reaction

appears in 24 hours. The height of the reaction occurs in 48-72 hours. However some patients with lymphopathia venereum give a negative Frei reaction. We have found no false positives with this test.

Since lymphopathia venereum is most often confused in the male with granuloma inguinale, fuadin can be given as a therapeutic test. If the disease is granuloma inguinale it will heal, if it is lymphopathia venereum the course will be unaffected.

TREATMENT—There is no satisfactory treatment for lymphopathia venereum Abscesses should be treated with hot packs and opened. Roentgen treatment is sometimes effective The sulfona mides seem to do no good. Sodium ascorbate (vitamin C) is said to be effective.

Diseases of the Penis

PHIMOSIS.—With phimosis there is inability to retract the fore skin. It is usually congenital but may be acquired as a result of a chronic inflammatory process or an underlying disease Carcinomas, urinary concretions, inspissated smegma and venereal warts may be hidden by phimosis. Balanitis is usually the result of a phimosis. Sometimes the opening in the foreskin is only of pinhole size. If the opening is swollen shut, the urine cannot escape and the fore skin forms a pouch filled with urine

Treatment—The treatment of phimosis is circumcision. There are many methods Circumcision is often badly done. Certain prin ciples need to be emphasized.

TECHNIC OF CIRCUMCISION

In an infant, no anesthesia is required. The first step is to see if the foreskin can be retracted. Any adhesions between the inner part of the prepuce and the glans penis are freed with a blunt pointed probe All the dried smegma is cleaned out and the parts are washed with alcohol.

The next step is to replace the foreskin so that it again covers

the glans Three small Kelly or mosquito forceps are placed—one in exactly the midline posteriorly, near the frenum, and two anteriorly, close together In placing these forceps the foreskin must be carefully seized in such a manner as to pull a little of the skin inward The three clamps are then picked up and the foreskin is put on stretch A slit is made with a scissors in the dorsum between the two clamps Care is taken not to cut too far, one should stop about ⅜ in from the corona The mucous membrane should be ⅜-½ in long Tension is continued on the clamps, and with the scissors the foreskin is trimmed around smoothly One should stay away from the frenum about ½ in All bleeders are clamped and tied with fine catgut Then, in babies, four catgut sutures are taken Number 1 is on the dorsum matching the two V-cuts which mark the middle, number 2 is at the frenum and is a mattress stitch; numbers 3 and 4 are at the sides The ends of these sutures must be left long after tying—3 in is enough Some sulfathiazole powder is placed along the line of the wound and a piece of vaseline gauze tied into the long ends of the sutures, forming a sort of crown Care must be taken not to place this vaseline gauze "crown" toc tightly A piece of gauze with a hole in it is slipped on and over the penis and secured with a single piece of adhesive tape, forming a flap which covers the penis and protects it

The only difference in circumcising an adult is that local anesthesia of ½ of 1 per cent novocain may be used, more careful hemostasis is carried out, and at least eight interrupted sutures are placed using silk instead of catgut The dressing is the same

PARAPHIMOSIS —In paraphimosis the prepuce has been retracted and edema has made replacement by the patient difficult or impossible Sometimes, because of balanitis, the patient will retract the foreskin to get at the infection, and occasionally in catheterization the physician will retract the foreskin and forget to replace it Edema often results rather quickly The pain is sometimes severe and the swelling marked Gangrene of the glans penis may result if the paraphimosis is not reduced

Treatment —The reduction of paraphimosis is simple. The physician puts on a pair of gloves (for his own protection) makes a "basket" of his index and middle fingers on both hands and seizes the penis behind the paraphimotic ring. Both thumbs are placed on the glans and used to press the glans firmly back through the constriction ring of the prepuce. At the same time a strong firm contraction is made with the fingers held in the basket formation. Steady pressure for as long as five minutes may be necessary before the glans will go back through the constricted ring However as soon as this is accomplished the swelling usually disappears promptly other means can then be instituted to care for the infection and trauma to the rather delicate structures.

To prevent recurrence, circumcision should be done as soon as the infection has subsided.

BALANITIS.—Balanitis is an inflammation of the glans penis, often the result of phimosis. It may accompany gonorrhea, and it is often associated with uncleanliness It occurs frequently in men with prostatic enlargement because of the irritation caused by dribbling urine. Balanitis may hide a chancre or a carcinoma. Recurrent balanitis not only may be produced by phimosis but may also cause phimosis. Balanitis in soldiers may become disabling, and for this reason all armies favor circumcision.

Treatment —In ordinary cases use of a little soap and water will effect a cure A little sulfathiazole powder applied topically several times a day will help control surface infection. Patients who have balanitis repeatedly should be circumcised.

BENIGN TUMORS.—Benign tumors such as fibromas, lipomas, myomas, chondromas, angiofibromas, fascial ossification, angiomas and melanomas all occur but rarely Fibromas usually are part of the picture of Recklinghausen's disease, and lipomas are commonly associated with fat tumors in other portions of the body Benign cystic tumors such as sebaceous cysts, and, rarely atheromatous cysts also occur A peculiar type of fairly common benign lesion is Fordyce's disease, characterized by milium like nodules of the skin

of the penis, usually occurring on the under surface It may be considered a benign type of nevus

Treatment —Some patients prefer to leave benign tumors alone unless they interfere with the sexual act. There is no necessity for treating Fordyce's disease or removing small simple melanomas

MALIGNANT TUMORS —These include carcinomas, teratomas, dermoid cysts of the median raphe, sarcomas, endotheliomas and Queyrat's erythroplasia. The last is quite rare

Etiology —The early manifestations of a cancer are the precancerous conditions such as keratosis, warts and papillomas It is difficult to distinguish a venereal wart from an early cancer, in fact, it cannot be done without a microscopic section in some cases Most cancers of the penis occur in persons between 40 and 60 In rare instances, they have been reported in males under 20 The commonest predisposing causes are phimosis that is a source of a rather persistent or chronic irritation, keratosis of the glans penis, recurrent warts around the glans or prepuce, Paget's disease of the glans and chancre and chancroid. Carcinoma of the penis is extremely rare in Jews, who are circumcised on the eighth day, but occurs frequently in Mohammedans, in whom circumcision is done at puberty At one time it was believed that penile cancers could be acquired by sexual contact with a woman who had a carcinoma of the cervix. This idea is erroneous, however, even though the two cancers are quite similar. both being of the squamous cell type

Symptoms —An ulcerating lesion that does not heal usually brings the patient to the doctor, but even so, often not early enough The onset is usually insidious and the lesion is painless in the early stages For these and other reasons, the patient delays consulting his doctor, so that the average lesion is about two years old when first seen by the physician and is. therefore, in a well advanced stage.

As the lesion progresses pain develops Metastases occur to the inguinal nodes which may become quite large and frequently fungate. In the more advanced lesions, the patient complains of

weakness from the toxic absorption of degenerating tissue or of difficulty of urination owing to encroachment on the urethra.

Diagnosis—There is no difficulty in recognizing the large fungating carcinomatous lesion that replaces the glans penis in late cases (Fig. 84) Early lesions may be confused with chancres or chancroid.

FIG. 84.—Carcinoma of the penis with extension to the inguinal lymph nodes.

However the patient's age and the ulcerated, spreading character of the lesion help differentiate these conditions. In early carcinoma, inguinal node involvement is rare, while in syphilis it regularly occurs.

The rarer endotheliomas begin as painful, bluish eminences on the glans penis, then break out farther down along the course of the corpora cavernosa (Fig 85)

Erythroplasia of Queyrat is characterized by a reddened slightly

raised, spreading irregular lesion most commonly on the glans penis and less commonly on the adjacent prepuce

Dermoid cysts and teratomas are of the adult teratoma type

A sarcoma usually produces much pain in the penis or perineum, considerable dysuria and occasionally retention of urine It may be confused with carcinoma of the urethra

Treatment —The treatment of malignant tumor of the penis is penile amputation It is often difficult to secure permission for this operation Some patients prefer to die with the cancer The patient

FIG 85 —Rare endothelioma of corpora cavernosa in man, 55

must be told what he has and what is proposed In early lesions partial amputation can be done and a functional organ obtained, but in late cases the entire organ must be sacrificed When inguinal metastases are present, these should also be excised to remove as much of the cancerous process as possible When the shaft is involved, not only must the penis be removed but also the scrotum and its contents Radium and roentgen therapy do little good.

Erythroplasia of Queyrat can be treated by fulguration alone Some endotheliomas are also treated in this manner, but partial amputation is better

FIBROSIS OF THE CORPUS CAVERNOSUM —This is a rather common condition and is known by many names such as fibrous cavern-

itis, strabismus of the penis, plastic induration of the penis, plastic concretions of the penis, sclerosis of the penis, indurated plaques of the penis and Peyronie's disease It is most often found in men from 40 to 60 and is rare in those under 30 The pathologic picture consists mainly of fibrous plaques growing parallel to the long axis of the organ and invading the septum or sheath of the corpora cavernosa. Only rarely do the plaques invade the cellular structure of the corpora. It is not malignant, therefore is localized.

Symptoms and Diagnosis —The patient first observes that on erec tion the penis bends to one side or in an upward direction forming the so-called fibrous chordee. This curvature gradually increases until in some cases intercourse is difficult or unsatisfactory The penis never turns down because the corpus spongiosum of the urethra is immune With the deviation the patient finds an indurated plaque on the dorsum. There is never pain connected with this disease.

The plaques are always on the dorsum of the penis, but can occur anywhere Their length varies from 1 to 5 or 6 cm. Usually only one of the corpora is involved, but sometimes both are affected.

The condition is sometimes confused with chordee However, in chordee the penile curvature is ventral and never dorsal or lateral. It may also be confused with carcinoma of the penis, but the smoother regular consistency of the lesion is sufficient to differen tiate them. Fibrosis may also be confused with fascial ossification of the penis. The latter is an osseous tumor and roentgen examina tion shows presence of the "bone" in the penis. Fibrosis of the corpus cavernosum may also show a few areas of calcific deposit on roentgen examination but never a piece of well developed bone

Treatment —A fibrous plaque of the corpus cavernosum should never be excised since it promptly recurs or the resulting scar is worse than the original disease. Treatment is not entirely satisfactory In some cases we have obtained excellent results with sulfanilic acid, but in others no effect has been obtained. We had one patient whose dorsal curvature was so marked that on voiding the stream was directed against the abdominal wall. For a time he voided by

lying on the stool Later he fashioned a tomato can so that he had a spout against which the stream was directed This patient was given 1 teaspoonful of sulfanilic acid (powder) four times a day for four weeks He gradually improved, and finally most traces of the fibrous induration disappeared Unfavorable results from this treatment are encountered, particularly when small calcific deposits are found To have any effect, the sulfanilic acid must be given in doses of 20 to 24 Gm daily for eight to 12 days

Application of a radium plaque directly to the lesion can be given a trial The dose must be carefully regulated so that it is neither excessive nor inadequate Some have reported cures in 66 per cent of cases, but this has not been the universal experience

VENEREAL WARTS —Venereal warts are contagious and may be acquired by sexual contact They are usually introduced through a small laceration around the genitalia They are often associated with general uncleanliness, chronic urethral discharge or phimosis Sometimes they undergo malignant degeneration They are found most frequently on the under surface of the prepuce, on the muco-cutaneous margin or on the glans itself

Treatment —Venereal warts nearly always recur if they are excised with a knife or scissors, so should always be removed with the endotherm knife One per cent novocain solution is infiltrated under the various lesions It is necessary to remove every lesion separately After thorough fulguration the area is dusted with sulfathiazole powder and a vaseline dressing applied The patient should be seen at weekly intervals to be certain that no small lesions were overlooked The wife may also need treatment The topical use of podophyllin causes these warts to disappear rapidly and merits a trial

HERPES PRAEPUTIALIS —This type of herpes is the local manifestation of a disturbance of the nerve roots as they leave the spinal cord somewhere about the third or fourth lumbar vertebra

It is a common disease usually situated on the prepuce or on the glans itself Little swelling occurs unless secondary infection is

superimposed. The lesions are superficial and characteristic, consisting of a small group of vesicles on an inflammatory base. They are usually accompanied by some burning and itching. The vesicles rupture, leaving a superficial area of ulceration which heals rapidly

Treatment—The application of B F I (bismuth formic iodide) powder two or three times daily is satisfactory The lesion will usually heal spontaneously if infection does not occur

ERYSIPELAS.—This disease is most commonly found in infants and in children following circumcision. It usually appears about a week following the operation and spreads rapidly over the penis and the entire body The lesion is similar to other generalized erysipelas in children. When untreated, the mortality is practically 100 per cent.

Treatment—The best treatment for erysipelas in children is sulfanilamide, which is far superior to either sulfathiazole or any of the other sulfonamides. Children tolerate sulfanilamide well A boy aged 4 can easily take one 5 gr tablet four times a day The erysipelas begins to disappear in 12 hours and is gone in 48 hours. The drug should be continued for five to seven days to guard against recurrence. Antistreptococcus serum is valuable but not nearly as effective as sulfanilamide. With sulfanilamide, the mortality of generalized erysipelas following circumcision is practically zero

OTHER INFLAMMATIONS OF THE PENIS.—Such simple lesions as boils can occur on the penis as well as elsewhere Rarer penile lesions are tuberculosis, diphtheria, actinomycosis and elephantiasis.

INJURIES OF THE PENIS.—Injuries may result from accidents or intercourse, may be self inflicted or may result from mayhem. Accidents to the penis are not particularly common. Abrasions, lacerations, contusions, denudations avulsions or gunshot wounds may occur The organ may be frozen as a result of exposure in colder climates

The commonest injury resulting from intercourse is the "hair burn." This is a small abrasion, most frequently seen on the prepuce, caused by introduction of one of the long hairs of the mons veneris

with the penis into the vagina The patient frequently becomes con-
cerned because he thinks he has a venereal disease Another injury
following sexual intercourse is a laceration of the frenulum with
rupture of the frenular artery Bites of the penis also may occur.
The paired character of the lesions makes the diagnosis

Now and then a patient becomes sufficiently psychopathic about
abnormal practices he is indulging in that he amputates the organ
Another injury occasionally produced by the individual is fracture
of the penis due to forcible reduction of a chordee Chordee, how-
ever, has disappeared since sulfonamide treatment of gonorrhea
Injuries to the penis may also be produced by the placing of various
foreign objects (such as rings, machine nuts or washers) around
the organ for masturbation When erection occurs there is some-
times so much edema that the foreign object cannot be removed

Treatment —In severe injuries, hemorrhage from the sinusoids of
the corpora is profuse and must be immediately controlled to save
the patient's life A tourniquet is placed around the base of the penis
and the injured sinusoids closed with catgut ties on a needle The
tourniquet is released before the skin is closed to make sure that all
bleeding areas have been controlled Severe injuries to the penis
are often accompanied by rupture of the urethra The ends of the
urethra must be approximated over a catheter and a suprapubic
cystotomy performed for diversion of the urine to give the urethra
and penis opportunity to heal Occasionally one of the vessels in
the penis is ruptured without tearing either the urethra or the cover-
ings of the organ The hemorrhage is then limited within Buck's
fascia The blood clot must be removed through an incision and
the vessel ligated

Lesser injuries, such as abrasions, need only some topical applica-
tion, such as sulfanilamide powder, to prevent infection Such minor
injuries as those to the frenular artery need only hemostasis and
ligation

The removal of foreign objects from around the penis often
requires considerable ingenuity

Diseases of the Epididymis

ACUTE EPIDIDYMITIS —Acute epididymitis may be of gonorrheal or nongonorrheal origin. Nongonorrheal infections may be due to staphylococcus, colon bacillus or pneumococcus. When it occurs during acute gonorrhea, it generally develops two to three weeks after onset of the discharge. With penicillin and sulfonamide therapy its incidence has been greatly reduced. Acute epididymitis may occur at any time during chronic gonorrhea, and may occur repeatedly Inflammatory lesions of the epididymis may also follow the passing of a sound, cystoscope or catheter and may follow or develop during the use of an indwelling catheter It may be the result of urethral injections or irrigations Some patients with acute or chronic prostatitis of nongonorrheal or gonorrheal origin may also have acute epididymitis The swelling often follows strenuous exercise, prolonged intercourse, long automobile rides or heavy lifting The route of invasion is through the vas deferens from the region of the seminal vesicles via the posterior urethra, although it is sometimes blood-borne.

Symptoms —The onset is rapid, so that often within 24 hours a well developed exquisitely tender swelling is present. The patient may report that prior to onset some tenderness was observed in the groin along the course of the spermatic cord. The patient is often quite ill complaining of malaise and sometimes chills and fever to 101 to 105 F He complains of severe pain in the scrotum and on examination the organ is often so tender that he will scarcely allow the physician to examine him

Examination and Diagnosis —On examination the scrotum is seen to be enlarged on the affected side Palpation reveals the epididymis much enlarged and extremely tender The epididymis is both elongated and enlarged in its short diameter so that it all but obliterates the testis in front of it. When caused by gonorrhea, there may be an associated urethral discharge, but in most instances the discharge practically stops with onset of the epididymitis. The reason for this

is not known, but it may possibly be due to the effect of the fever on the gonococcus The patient with acute epididymitis looks prostrated The white blood cell count may be only moderately elevated but is often over 20,000 In some instances the epididymis may abscess and rupture through the skin, particularly with epididymitis of staphylococcic and Bacillus coli origin

The acute infection usually subsides in a week, although the epididymis may still be quite large The size gradually decreases but the epididymis sometimes may be felt for several months and even six months later may still be palpably enlarged

Acute epididymitis is sometimes confused with acute orchitis However, careful examination will reveal the unaffected testis situated in front of the extremely tender and swollen epididymis It should not be confused with tuberculous epididymitis

Treatment —The patient should be put to bed and a large-size suspensory applied snugly During the early acute stage application of an ice bag under the scrotal sac relieves pain and aids in preventing further development of the swelling After 48 to 72 hours, continuous heat should be applied This is generally supplemented with hot sitz baths three times a day

For the pain, 1 gr of codeine sulfate with 5 gr of aspirin in a capsule should be given every four hours, and less frequently as the pain diminishes

Penicillin causes rapid reduction of pain and swelling The drug should be administered in doses of 30,000 units every four hours for at least five days Inadequate doses will result in relapse

The intravenous administration of iodides is particularly valuable and may be used in conjunction with foreign protein therapy Ten cubic centimeters of a 10 per cent solution of sodium iodide, obtainable in ampules, is given intravenously every other day On alternate days a foreign protein, such as 5 cc of proteolac, 2 cc of activin or 5 cc of whole boiled milk, is given intramuscularly Calcium gluconate intravenously is valuable but not as effective as sodium iodide and constitutional reactions are more severe

When the infection is of gonorrheal origin, sulfathiazole should be continued. If sulfathiazole has not been given, it should be started in full doses of 15 gr four times a day If sulfathiazole has been regularly given before 7½ gr doses three or four times a day are adequate

CHRONIC EPIDIDYMITIS.—Chronic epididymitis when of gonococcic origin, is usually only a continuation of recurring attacks due to an uncured or chronic gonorrheal infection. It is not as severe as the acute form but quite troublesome. Chronic epididymitis is more often caused by nonspecific infection than it is gonorrheal in origin.

Treatment—Treatment should be directed toward removal of foci of infection, which are usually in the prostate, seminal vesicles or pockets in the urethra. The patient therefore should have prostatic massage once a week (Figs. 76 and 77 pp 257 and 258) If a stricture is also present, the urethra should be dilated with sounds of increasing size. It is usually best to dilate the urethra on some day other than that on which prostatic massage is given. Weekly prostatic massage may have to be continued for many months until the infection is under control

The use of iodides intravenously at the time of massage and passage of sounds, as described under treatment of acute epididymitis, is of value. However if iodides are given too frequently or too long some patients become sensitized and have constitutional reactions or skin eruptions.

Penicillin and sulfathiazole may be given in repeated courses whenever a frank urethral discharge is present.

EROTIC EPIDIDYMITIS—Erotic epididymitis, or neuralgia of the epididymis, is a common affliction and is due to ungratified sexual desire. Unless it continues longer than 24 hours the condition is rarely seen by the physician. Use of a suspensory and application of an ice bag may be prescribed.

TUBERCULOUS EPIDIDYMITIS.—This condition is described in Chapter 6

TUMORS AND CYSTS—Tumors of the epididymis are very rare and present no characteristic symptoms

Cysts of the epididymis are quite common and are usually classified as spermatoceles They may be found in children as well as in adults The cysts originate either from an aberrant tubule or from the obstructed normal tubules or rete testis at the head of the epididymis Unless they become painful or greatly enlarged they are of no particular importance These cysts may contain spermatic fluid in which spermatozoa may be found, but clear cysts without sperms are also encountered in the epididymis In adults, the differentiating point between cyst of the epididymis and hydrocele rests on the finding of spermatozoa in the aspirated specimen

Treatment —Cysts of the epididymis sometimes can be destroyed by sclerosing fluids The contents of the cyst are first withdrawn with a syringe and needle and the sclerosing fluid injected without changing the position of the needle Quinine-urea hydrochloride and urethane is satisfactory

Tumors of the epididymis should be removed surgically Most solid tumors of the epididymis are malignant

SYPHILIS —There are three forms of syphilis of the epididymis, all rare (1) acute interstitial epididymitis, (2) chronic interstitial epididymitis, (3) gumma of the epididymis One must be careful in making such diagnoses because syphilis of the testis is much more common and the epididymitis may be only secondary to it

Treatment —The administration of penicillin or bismuth intramuscularly for several weeks should cause a prompt remission

INJURIES —The epididymis suffers traumatisms which are a part of injuries to the testis and the cord Use of a suspensory and application of an ice bag may be prescribed Codeine may be necessary

Diseases of the Testes

ORCHITIS OF MUMPS —Epidemic parotitis is usually mild, but in 30 per cent of adults with mumps there is orchitis followed by

degeneration, with atrophy of the testis in 55 per cent of those so affected. In bilateral cases, therefore there is a high percentage of sterility Degeneration of the testis occurs almost never when mumps takes place before puberty

Symptoms and Diagnosis —The incubation period of epidemic parotitis is two or three weeks and may be even longer Orchitis is most apt to occur about the eighth day after onset. It is therefore important for every adult with an acute parotitis to stay in bed at least two weeks. In a few instances the orchitis may occur before the parotitis, and it may even occur without parotitis.

At the onset of parotitis the temperature is 101 F or higher and within 48 hours the swelling in the parotid region reaches its maximum. In a third of the cases only one side is involved in the remainder the opposite side becomes swollen in one to five days. Sometimes the submaxillary and sublingual glands are also affected. After persisting for seven to 10 days, the swelling gradually subsides.

When orchitis develops, the testicular swelling reaches its maximum in four days and then gradually subsides. When the infection is severe there may be an associated urethral discharge With orchitis, leukocytosis develops With uncomplicated epidemic parotitis there is leukopenia

Examination reveals the testis greatly swollen and exceedingly tender There may be some effusion of fluid into the sac of the tunica vaginalis.

Treatment —The patient should be kept in bed and a snug suspensory applied. An ice bag under the testis, and codeine and aspirin by mouth relieve the pain. Local counterirritants, such as iodex or ichthyol ointment, are of value.

NONEPIDEMIC ORCHITIS.—This is very rare, since the epididymis serves to protect the testis from infection.

ABSCESS.—This is usually the result of a severe suppurative type of epididymitis, although occasionally such abscesses are primary in the testis. The sac of the tunica vaginalis may also be full of pus.

Treatment consists of incision and drainage.

SYPHILIS OF THE TESTES —Gummas are the commonest form of syphilis of the testis The testis is small and hard and must be distinguished from tumor The Wassermann reaction is almost always positive The prompt recession of the lesion following a few injections of bismuth will establish diagnosis and rule out doubtful lesions

TUBERCULOSIS —Tuberculosis of the testis is always secondary to tuberculous epididymitis

FIG 86 —Malignant teratoma of the testis with metastases to the inguinal lymph nodes

TUMORS —Tumors of the testis represent about 2 per cent of all tumors occurring in males Benign tumors are rare and consist mainly of solid and cystic adenomas, dermoid cysts and benign embryomas Most testicular tumors are malignant and metastasize early Malignant tumors may be classified into several groups in order of decreasing malignancy (1) chorionepitheliomas, (2) seminomas, (3) embryonal carcinomas and (4) adult teratomas (Fig 86) Testicular tumors can occur at any age but are most common in young men

Symptoms —The patient usually complains only of increased size

of the testis. This is likely to be observed following an injury although the injury may have had no relationship to the tumor Medical students are about the only ones who ever suspect testicular tumor early enough. They usually find a small lump in the testis or testicular area and consult a doctor at once

Sometimes the signs of metastases are the first symptoms observed. The patient may complain of cough if metastases to the lungs have occurred, or he may show signs of a cerebral tumor due to brain metastases Testicular tumors usually spread to the retroperitoneal lymph nodes the abdominal tumor or tumors, may be extremely large and the testicular lesion go unnoticed.

Patients with a chorionepithelioma usually show some endocrine disturbances. The breasts often enlarge and a milky secretion may be obtained. The pubic hair line may assume a horizontal female distribution. Other female characteristics, such as increased round ness of the thighs and hips, may be evident. The Aschheim Zondel reaction is positive.

Examination and Diagnosis—Often by the time the patient is seen by the doctor the testis is quite large and replaced entirely by tumor tissue. The tumor then has a characteristic firm sensation on palpation. It may be irregular or may be perfectly smooth. Irregular tumors are usually teratomas but smooth teratomas are not uncommon.

Small tumors can be distinguished from the normal testicular tissue by palpation. A large, thickened epididymis may cause some confusion. A tumor may occur in association with a hydrocele. It can then be palpated only after the hydrocele is drained.

Treatment—The treatment of a testicular tumor consists of surgical removal of the tumor and the testis followed by deep roentgen therapy to the abdomen and local area. As much of the spermatic cord as possible should be removed. Roentgen therapy alone should never be used.

TORSION OF THE CORD.—This is due to a sudden twisting of the spermatic cord. It may or may not be produced by an injury

A long spermatic cord is probably a factor in its occurrence It can occur at any age, including infancy It may reduce itself and then occur again It may also occur bilaterally.

Symptoms and Diagnosis —The patient complains of sudden severe pain in the scrotum Nausea, vomiting, chills and fever may occur The testis is tender and swollen If untreated, gangrene and abscess formation rapidly result

Treatment —Sometimes torsion can be reduced by manipulation. If this is not possible, an attempt should be made to reduce the condition by operation If this is not possible, an orchidectomy should be performed

UNDESCENDED TESTES —This condition may be treated (1) expectantly, (2) medically or (3) surgically

1. *Expectant* —However unsound the do-nothing method may be, a considerable number of testes descend to normal position about puberty There is no sure way of distinguishing between natural development and response to medication

2 *Medical* or *Endocrine* —There is no unanimity of opinion regarding the best medical procedures, although some testes do take a normal position in the scrotum as a result of endocrine therapy Contraindications are migratory or aberrant testis, hydrocele or hernia, other anomalies and puberty Treatment should not be begun before 9 years or after puberty Preparations of the gonadotropic hormone from pregnancy urine or of the anterior pituitary lobe and the testosterone group may be used Gonadogen (Upjohn), gonadin (Cutter), anteron (Schering) or a similar product should be injected deep in buttocks every other day in doses of 100 to 200 R U until a total of not over 4,000 R.U has been given If testosterone propionate (oretone, perandren) is used, 5 mg is injected three times a week for not longer than four weeks The child should be examined frequently for secondary sex changes In no case should treatment continue over three months

3. *Surgical* —This is undertaken when the expectant and medical treatments fail, the testis is aberrant or migratory or hernia or hydro-
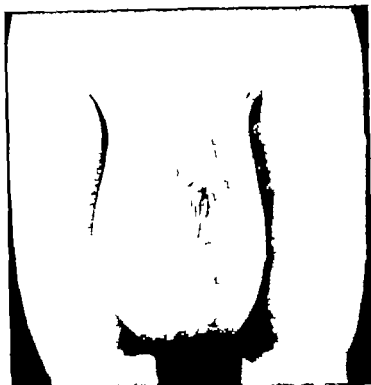
FIG. 87—*Above* enormous bilateral hydrocele, with disappearance of penis. *Below left* moderate uncomplicated bilateral hydrocele. *Below right* large hydrocele of right tunica vaginalis, most of the mass being hernia, finger points to outlet for vanished penis.

cele is present We consider the best operation to be Torek's orchid opexy or one of its many modifications

INJURIES OF THE TESTIS —Contusions and wounds are not un common Dislocation or luxation of the testis may result from violence, the testis being driven into the inguinal region, under the skin of the penis, into the area of the anterior superior spine of the ilium or even up into the suprapubic region The testis should be replaced if possible or removed surgically

The tunica albuginea may be injured during surgery, such as excision of a varicocele The testicular tubules which ooze out should be replaced and the tunica closed with catgut

Diseases of the Tunica Vaginalis

HYDROCELE.—Hydrocele of the tunica vaginalis is the commonest form of this condition, although it may also occur in the spermatic cord The cause of hydrocele is unknown However, many occur secondary to inflammatory lesions of the testis or epididymis or in association with tuberculosis or a testicular tumor It may occur at any age

Symptoms —The patient complains only of the increasing size of the scrotum, and in many instances makes his own diagnosis Because of the size of the sac, the penis may become either partially or entirely enveloped (Fig 87) Occasionally secondary inflammation occurs, particularly after tapping, and with this localized heat and tenderness develop

Diagnosis —Hydrocele must be differentiated from hernia, testicular tumor, gumma and hematocele The usual method of diagnosing a hydrocele is by transillumination When a flashlight is pressed firmly against the under aspect of the scrotal sac, there will be a clear, pinkish transmission of light if the condition is hydrocele However, if the contents of the hydrocele are cloudy or the walls thickened as the result of an old inflammatory process, the test will fail The larger testicular tumors are sometimes confused with hydro cele The firm, heavy character of a tumor, however, helps in differ-

entiating the two conditions. Gummas should not cause confusion, for they are small and hard. The sudden onset of a hematocele as compared with the gradual development of a hydrocele should serve readily to differentiate the two

Treatment —Treatment may be palliative or curative. Palliative measures consist of tapping the scrotal sac as often as it becomes filled with fluid. The intervals may vary from a few weeks to a year or more Curative measures consist of (1) injection therapy and (2) surgical excision and inversion of the sac.

1 Injection therapy This is not a new procedure. Use of the older agents, such as phenol or iodine, was always accompanied by severe pain, and disability was usually greater than that from an operation. The newer agents, however, cause little pain and practically no disability

The skin is shaved over a small area of the most dependent portion of the scrotum a small spot painted with tincture of iodine and a small wheal of 1 per cent novocain solution made. A no 17 needle is then introduced into the scrotal sac and the fluid withdrawn with a syringe. If much fluid is present, the needle may be connected to a piece of rubber tubing and the fluid removed by gravity flow In small hydroceles, one 2 cc. ampule of quinine-urea hydrochloride and urethane is then injected in large hydroceles, two ampules are used. It is important that as much of the fluid as possible be removed to prevent dilution of the drug After the drug has been injected the scrotum is carefully massaged to distribute the fluid. A firm suspensory is then applied.

Many hydroceles can be cured by a single sclerosing injection, although a few may need reinjection. When a hydrocele recurs repeatedly we prefer surgical excision. There are other injection agents, including sodium morrhuate and quinine dihydrochloride, but they are accompanied by more pain and disability than is quinine urea hydrochloride and urethane

2. Operative therapy Operation for hydrocele consists of excision of the redundant portions of the sac and inversion of the sac behind

the epididymis so that the mucous surface of the remainder of the sac, as well as the testis, lies under the subcutaneous tissue This insures absorption of any fluid which may form subsequently

Diseases of the Spermatic Cord

VARICOCELE —A varicocele is a dilatation or varicosity of the veins of the pampiniform plexus of the spermatic cord It most commonly occurs on the left side, and usually appears in youths shortly after puberty In most instances, small varicoceles will disappear during the third decade In a few cases, the varicocele continues beyond the thirtieth year and may continue to increase in size There are no particular symptoms unless the varicocele becomes extremely large

Treatment —Most varicoceles should be let alone It is seldom necessary to operate, since varicoceles in young men will disappear on marriage In older men, they rarely give rise to any symptoms

However, if a varicocele produces a dragging sensation or actual pain, a portion of the veins can be removed In a varicocelectomy, care must be taken to identify the spermatic artery and the vas deferens and to separate them first from the maze of veins so that they will not be injured About two thirds of the veins may be removed safely by ligation and excision A suspensory should be worn for four to six weeks after the operation

HYDROCELE —A hydrocele of the cord may appear as a long sac or as a small cystlike mass following the cord Hernia may coexist In a few cases, such a hydrocele may communicate with the peritoneal cavity Unless it communicates with the peritoneal cavity, a hydrocele may be evacuated and a sclerosing solution such as quinine-urea hydrochloride and urethane injected

ACUTE DEFERENTITIS —Acute inflammation of the vas deferens is common before the onset of acute epididymitis The patient usually complains of neuralgic pain and tenderness along the course of the cord When the epididymis becomes swollen, the tenderness along the vas deferens becomes secondary in importance

The vas deferens may also become involved in tuberculosis of the genito-urinary tract. Examination reveals it to be thickened and sometimes nodular

Treatment —Treatment is directed to the underlying cause of the deferentitis.

TUMORS.—Tumors of the spermatic cord are rare. The vas deferens seems to be the organ from which such tumors arise. Lipomas are sometimes found along the cord as small fatty tumors.

INJURIES OF THE SPERMATIC CORD —These are usually accompanied by considerable hemorrhage since the spermatic cord is extremely vascular Direct trauma to the cord is often accompanied by considerable shock. Injury to the cord may also occur at operation for inguinal hernia

Treatment —This consists of ligation of the injured blood vessels and such anatomic restoration as is possible.

FILARIASIS OF THE SPERMATIC CORD —The lymphatic vessels of the spermatic cord are frequently the only portion of the lymphatic system affected by filariasis in its early stage The disease should be considered if there is a history of residence in a filarial region together with tenderness and swelling of the spermatic cord. There may or may not be associated involvement of the epididymis, scrotum or extremities.

Diseases of the Scrotum

SKIN DISEASES.—Various skin diseases involve the scrotum including erythema intertrigo (chafing) eczema simplex, eczema marginatum (ringworm), pityriasis versicolor pediculi pubis, scabies, actinomycosis and erysipelas.

1 Erythema intertrigo (chafing) commonly occurs in fat individuals and is common in children. It is caused chiefly by moisture from urine or perspiration and friction due to walking

2 Eczema simplex is a common type of eczema which occurs around the scrotum. It is said to occur most frequently in persons subject to rheumatism and gout.

3 Eczema marginatum is a ringworm infection modified by eczema or eczema intertrigo The parasitic nature of this disorder may not be recognized at first It occurs in patches with elevated borders and well defined margins, characteristic central healing and peripheral advance

4. Pityriasis versicolor occurs in yellowish-brown spots or patches on the scrotum It is caused by a fungus, Microsporon furfur Sodium hyposulfite is practically specific

5 Pediculi pubis These parasites infest clean as well as dirty people The ova or nits are attached to the hair, and care is needed to rid the patient of the trouble Ten per cent DDT powder in talc applied daily for three days will kill the organisms Shaving is not necessary DDT in solution may also be sprayed on

6 Scabies This disease is usually on the hands of the patient and is carried from there to the genitalia The characteristic burrows of the parasite, excoriated papules and many crusts are seen Itching is always most marked at night and is almost invariably present owing to the migratory movements of the mites Sulfur is used in treatment

7 Actinomycosis is important because it can easily be confused with tuberculosis which it may resemble Smears from the lesions will reveal the ray fungus

8 Erysipelas of the scrotum may occur in conjunction with gen eralized erysipelas

INFECTIONS —Cellulitis, abscess and gangrene of the scrotum are usually due to infections of the deeper structures but may occur in dirty individuals as a result of entrance of infection through the crypts of the skin When gangrene is spontaneous, it is called spontaneous fulminating gangrene

Symptoms and Diagnosis —The onset of all infections of the scrotum is sudden, with marked rise of temperature, chills, nausea, vomiting, prostration or delirium Swelling is rapid, and pain is a prominent symptom The scrotum is exceedingly tender and pits on pressure At first the scrotum is red, later it becomes dull in appearance If gangrene results, the skin breaks down and a foul

FIG. 88.—Filarial elephantiasis. (Courtesy Dr H. L. Weber medical missionary in West Africa.)

discharge is produced The scrotum will slough off in about a week, leaving the testes exposed

Treatment.—In cellulitis, abscess or gangrene, the scrotum should be well opened and through-and-through drains inserted Irrigation with aqueous solution of azochloramide (Tiernan) is of value. Hot packs should be applied If there is an associated (perhaps etiologic) urinary extravasation, it should be treated as described in a later section on urethral urinary extravasation (p 319).

ELEPHANTIASIS —Two varieties are seen in clinics in the United States, the filarial and nonfilarial The latter is the most important to us Essentially, elephantiasis of the scrotum is a hard edema and hyperplasia of both the skin and connective tissues due to blocking of the superficial lymph channels

The filarial type is confined to certain tropical localities and to persons who have lived in the tropics (Fig 88) The disease is due to the nematode known as Filaria sanguinis hominis, Filaria nocturna or Filaria bancrofti The larval forms found in the blood are transparent, colorless and cylindrical, about 0 3 mm long and about the width of a red blood corpuscle In a fresh specimen of blood the larva can be seen wiggling within its encasing sheath, the cylindrical covering not changing its position on the slide Curiously enough, these larvae are in the victim's peripheral blood only at night, generally at midnight, the situation may be reversed if the patient sleeps in the daytime

We have the word of a medical missionary in West Africa, in the Cameroon district, who has performed over two thousand operations on natives for this disease, that the elephantiasis is usually accompanied by hernia Natives readily submit to operation because the end-result is a cure A native will come many miles over the jungle paths and trails, often wheeling the tremendously hypertrophied scrotum in a wheelbarrow ahead of him The scrotum in these cases often weighs 200 lb or more

The second, or nonfilarial, type is seen occasionally in practice in the United States (Fig 89) It may be due to a variety of causes,

FIG. 89—Nonfilarial elephantiasis of the scrotum in American Negroes. *Above* in syphilitic patient, though probably not due to the syphilis. *Below* enormous involvement (courtesy of Dr T G Orr Kansas City)

among them syphilis The underlying pathologic process is the same, the blocking of the lymph channels taking place through the activity of spirochetes or other means

Treatment —Success of operative treatment depends on the same principle, whether filarial or nonfilarial elephantiasis is operated on anastomosis of the superficial lymph channels to the deep lymph

FIG 90 —*Left,* primary carcinoma of scrotum, so-called chimney-sweep carcinoma, attributed to carcinogenic substance in soot. *Right,* large fungating inguinal lymph node, extension of primary carcinoma of scrotum.

system It is a rather simple procedure A large slit is made over the anterior portion on either side of the scrotum where the testes should be and the testes and cords are located The next step is to trim off all excess tissue, leaving only enough skin to make a flap to cover the denuded testes and cords This automatically connects the superficial lymph to the deep channels, and cure is permanent.

TUMORS —Tumors of the scrotum may be benign or malignant. The commonest are benign and are usually sebaceous or ather-

omatous cysts. Rarer lesions, such as lipomas, fibromas, hemangiomas, lymphangiomas and chondromas may occur

Malignant tumors are usually epitheliomas, but they are not common. They are supposed to be common among workers in mineral oil paraffin. tar dyes, cotton mills, etc., but no one has seen a

FIG. 91 —Unusually pendulous scrotum which the patient wanted shortened.

large enough series to draw any valuable conclusions. The condition was formerly called chimney sweep carcinoma (Fig. 90)

Certain pastoral tribes in Kurdistan who live on the high plateaus, where the days may be exceedingly warm and the nights bitterly cold, are said to have developed the custom of swinging a pot of burning charcoal between their widespread legs and wrapping the long loose burnoose or garment about it for warmth Carcinoma of the scrotum is said to be common among these people

Another rare type of malignant tumor of the scrotum is Paget's disease, which is similar to that found in the breast.

Treatment —The treatment of both benign and malignant tumors of the scrotum is excision In the case of malignant tumors, the loose character of the scrotum permits wide excision of the mass Excision of malignant tumors is preferred to radiation because of the sterilizing effect of x-ray therapy The inguinal glands should be removed

RELAXATION OF THE SCROTUM.—This disorder is sometimes the complaint of a colored Lothario whose scrotum hangs midway to his knees (Fig 91) We have done a shortening operation, to the immense satisfaction of the patient

INJURIES OF THE SCROTUM —Severity of scrotal injury may vary greatly There is usually some associated injury to the scrotal contents Occasionally trauma to the scrotum may produce a hematoma without breaking the continuity of the skin Sometimes a considerable quantity of tissue is lost, particularly in war injuries

Treatment —The treatment varies with the individual case With severe injuries, control of hemorrhage is most important The remaining scrotal tissue is usually adequate to replace any tissue which is lost Should it be inadequate, the remarkable powers of regeneration of the scrotum will eventually heal over the exposed area

Diseases of the Male Urethra

THE MALE urethra is partly an internal and partly an external organ. Its main function is to convey the urine from the bladder to the outside. It functions also partly as a sexual organ.

Gonorrhea, which is the most important disease of the male urethra, is considered in Chapter 21 We shall discuss here the following diseases of the male urethra stricture nonspecific urethritis, extravasation of urine diverticulum traumatisms and false passage, tumors tuberculosis, syphilis, and urethral chill or catheter fever

Stricture

Stricture of the urethra means loss of dilatability of any portion of the urethra. There are two general varieties (1) spasmodic, and (2) organic or permanent including acquired (inflammatory traumatic, chemical) and congenital.

SPASMODIC STRICTURE —This is not a real stricture but a temporary spasmodic contracture of the external sphincter It is the sort of "stricture" that commonly follows surgical operations Sometimes it is psychic in origin, usually occurring in persons with slightly unstable nervous make up

Such a "stricture" can effectually prevent the passage of an instrument into the bladder The catheter is passed down the urethra and meets the spasm just at the external sphincter Continuous steady pressure against this spasmodic sphincter frequently relaxes it, permitting the catheter to pass Injection of 2 per cent metycaine or 1 per cent pontocaine into the urethra is a great aid. Hot sitz baths

and hot applications to the perineum and abdomen are helpful. The condition usually occurs in young adults

INFLAMMATORY STRICTURES —These strictures of the urethra are nearly always the aftermath of acute gonorrhea Just how or why, no one has satisfactorily explained. Some believe that the severity of the original acute gonorrheal urethritis causes damage that results in the stricture Others contend that it is the chronicity of the disease that causes the strictures Indeed, both views may be correct.

In inflammatory strictures the pathologic process is simple The inflammation from infection involves the deeper structures of the urethra and produces a circular zone of congestion in the urethral wall. When this tends to heal there is round cell infiltration, and yellow elastic fibers are laid down This forms an annular ring of fibrosis around the urethra, narrowing its lumen These fibers are circular and tend to interlock When healing takes place these circular fibers contract and constrict the lumen of the urethra The pressure of the urine behind the stricture sets up new inflammatory processes

In his book *Stricture of the Urethra,* published in 1852, Sir Henry Thompson of London stated that he examined not less than 300 pathologic preparations of stricture of the urethra and made careful notes in 270 cases He divided the urethra into three regions

Region I—1 in. before and ¾ in behind the junction of the spongy and membranous urethra, the superficial layer of the triangular ligament being the point from which these measurements were made

Region II—Extending from a point 1 in in front of the superficial triangular ligament to within 2½ in. of the external urinary meatus

Region III—The 2½ in of the terminal urethra, including the meatus and the fossa navicularis

Thompson studied 320 strictures, located as follows region I, 67 per cent, region II, 16 per cent, region III, 17 per cent. In a few cases there were multiple strictures These proportions, noted nearly

a hundred years ago still obtain, for we find strictures in these locations in the same ratio as Thompson found them

Strictures may be of large or small caliber The large ones are inflammatory zones that ring the urethra but do not obstruct the flow of urine. At this stage the patient never comes for relief of obstructive symptoms but complains of a slight chronic discharge or a burning sensation in the urethra. If the stricture is seen at this time, the urethroscope is the best instrument with which to make the diagnosis. The strictured area appears reddened and congested the nice even folds of the normal urethra are lost and there are only two or three folds

The strictures that follow gonorrhea form in two to 15 years.

Treatment —Treatment is either dilatation or cutting Usually the patient waits until the urinary stream is impeded to an alarming degree, by which time it is necessary to start with a filiform A spiral tipped filiform is passed through the stricture. To this is screwed a follower the best being the woven bougie type which will do no damage and will more readily follow the filiform through the stricture One should be content the first time if the stricture is dilated to 16 F One should be careful not to cause bleeding After a week the procedure is repeated increasing the size of the dilating instrument.

We give every patient with stricture the same instructions

1 A dilatation every week for six weeks.

2 A dilatation every two weeks for 12 or more weeks.

3 A dilatation once a month for six more months.

4. A dilatation once every six months for life

However we have never yet had a patient who carried out this program. As soon as the urine passes normally again, he is not interested in further treatment. We write telephone and telegraph him and send word to him by friends to come in for treatment, but only rarely does he come back until he is in trouble.

Troublesome strictures may be successfully cut" by a urethrotome.

Inflammatory strictures may occur, though rarely, from causes other than gonorrhea, for example, the prolonged wearing of an indwelling urethral catheter.

TRAUMATIC STRICTURE —Stricture may follow unskilful instrumentation of the urethra, but this is apt to be true only if the instrument is pushed through the urethral wall

FIG 92 —Fractured pelvis, with urethral stricture resulting from failure to treat the ruptured urethra. Such traumatic stricture shortens life.

Fracture of the pelvis often results in serious injury to the urethra (Fig 92). Several years ago we had a case of fractured pelvis and rupture of the urethra in a boy of 16. He and some companions were on a wild automobile ride and had an accident. The others were killed, but our patient had a badly fractured pelvis He found he could walk with difficulty. He walked a mile for help, and during that walk the shattered fragments of the pelvic girdle ground the

prostatic and membranous portions of the urethra to shreds. The final disposition of this case was transplantation of the ureters to the bowel. We read a great deal about how stricture of the urethra might be prevented in cases of rupture of the urethra from trauma, but we have had early cases and found that we were sometimes unable to do more than try to save the patient's life.

Straddle injuries in boys are common. If the injury is severe, the urethra is ruptured by pressure of the blow against the symphysis pubis.

Treatment is always surgical.

CHEMICAL STRICTURES.—Such strictures are fortunately rare. We have had patients who injected strong carbolic acid into the urethra with disastrous results. We have also known cases in which strong caustic soda was injected by mistake. The urethral membrane being very delicate, can easily be destroyed by chemical burns. Complete obliteration of the urethra often follows such chemical strictures.

CONGENITAL STRICTURE.—This includes all forms of obstructive developmental defects as they relate to the urethra, discussed in Chapter 10

Nonspecific Urethritis

Nonspecific urethritis is the name given to all urethral discharges that cannot be proved to be gonorrheal in origin. We believe that 75 per cent of all cases of urethritis are nonspecific. Among the most common organisms responsible for nonspecific urethritis are Bacillus coli, streptococci of various types, typhoid and paratyphoid bacilli, pneumococci and Micrococcus catarrhalis. The disease is usually acquired by sexual contact. It may be gotten from the mouth or anus by perverted practices.

One must be careful to differentiate nonspecific urethritis from urethral discharge due to prostatitis.

SYMPTOMS.—There is a urethral discharge with no particular discomfort in the urethra. There may be tickling and itching and, on rare occasions, burning and frequency of urination. The incuba

tion period is somewhat in doubt, it probably varies from three to 14 days

These discharges rarely cure spontaneously Sometimes the urethritis is persistent The patient usually becomes highly introspective and squeezes and strips the urethra several times a day to see if he can obtain a little bead of pus

The treatment is the same as for gonorrhea

Extravasation of Urine

Extravasation of urine into the tissues follows or accompanies the retention of urine due to a sudden closure of a stricture of the urethra Complete rupture of the urethra does not result in any marked degree of extravasation of urine In 15 cases of urethral urinary extravasation studied by us, traumatic stricture was present in five. Urinary extravasation is a much more common complication of traumatic than of gonorrheal stricture

Urinary extravasation probably begins in an infected gland or pocket of scar tissue in the urethra resulting from some old infection or injury proximal to a stricture This pocket increases in size as a result of repeated straining to void until its wall becomes paper-thin When rupture of this wall finally occurs, urine escapes into the surrounding tissue with each act of micturition The amount of urine escaping probably varies with the size, location and shape of the opening and severity of the stricture. In some cases the urine escapes slowly and leads to a condition resembling elephantiasis Sometimes extravasation results from dilatation of a urethral stricture, either at once or after an interval. Other causes of urinary extravasation from the urethra are obstruction by a urethral stone, and rupture of a periurethral abscess In a few cases in infants the etiology has not been clear.

SYMPTOMS AND SIGNS —The patient complains of a sudden sharp, spontaneous pain, usually in the perineum, followed by swelling and increased difficulty in urinating The location of the swell-

ing depends on the location and size of the rupture and, to some extent, on its duration.

In most instances there has been previous difficulty in micturition, due either to a gonorrheal or to a traumatic stricture. When first seen, the patient generally feels quite ill and there may be complete urinary retention.

The affected parts are at first greatly enlarged and quite tender to the touch. The patient appears toxemic and may have chills and fever. The pulse is somewhat faster than normal. The white blood cell count is elevated, ranging from 14 000 to 28 000 in the acute stages. The urine when first obtained contains considerable albumin. The nonprotein nitrogen and creatinine contents may be elevated. Later the patient may exhibit mental confusion progressing to delirium and coma.

As extravasation progresses, necrosis of tissue occurs, particularly in the perineal type. There may therefore be darkened areas on the scrotum and penis if extravasation has been of sufficient duration. Necrosis is probably due not to the irritative properties of urine but to the pressure of the urine which cuts off the blood supply of the tissues.

DIRECTION OF EXTRAVASATION —Since 66 per cent of urethral strictures involve that portion of the urethra beginning ¾ in. behind and ending 1 in. in front of the triangular ligament, it is natural that most cases of urinary extravasation have their origin here. In fact, urinary extravasation rarely occurs in any other location. The direction which extravasated urine takes depends on the relationship of the point of rupture to the planes of the surrounding fascia (Fig. 93).

Urinary extravasation from the urethra is usually classified according to its origin as (1) penile, within Buck's fascia (2) perineal, anterior to the triangular ligament (3) pelvic, posterior to the triangular ligament (into the ischiorectal fossa or the subperitoneal space), and (4) intraligamentous, within the triangular ligament.

Extravasation in Buck's fascia is uncommon and is due to a rupture in the penile portion of the urethra The swelling is limited to the penis alone

In the perineal type the point of rupture is anterior to the urogenital diaphragm (triangular ligament) This means that the extravasated urine will be limited by Colles' fascia (superficial perineal
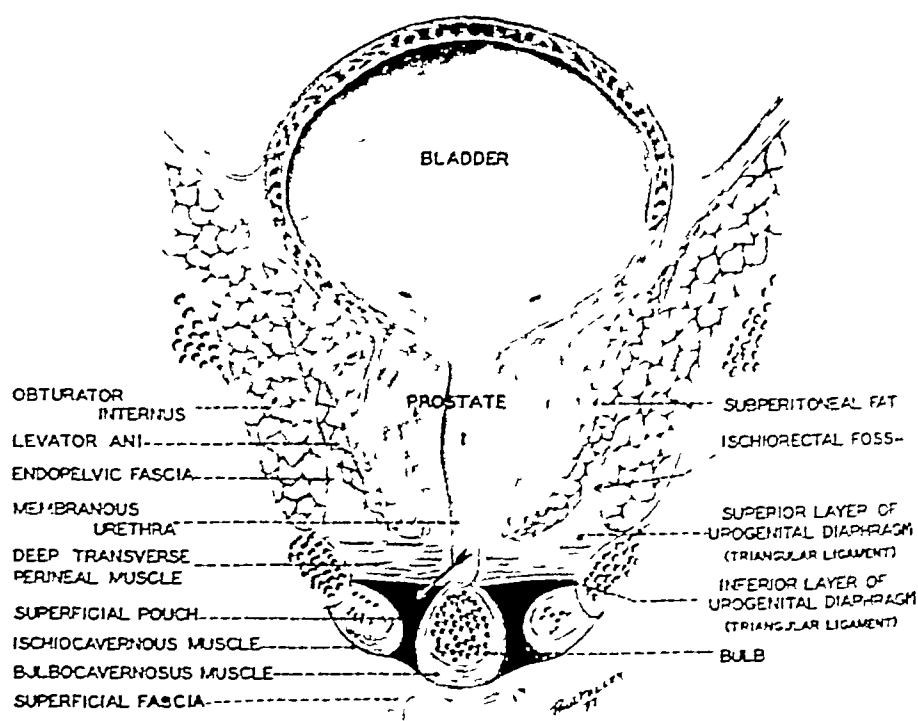
FIG 93 —Escape of urine into the tissues in extravasation of urine *Arrow* shows where urine escapes from urethra into tissues in certain cases

fascia), the reflected portion of which forms the superficial layer of the urogenital diaphragm In front of this layer of Colles' fascia is the superficial perineal pouch which is enclosed by the union of the deep and superficial layers of Colles' fascia in front of the anus Both layers of Colles' fascia are firmly attached to the ischiopubic rami and ischial tuberosity, but its superficial layer covers the scrotum and penis and extends up over the abdomen to become continuous with the deep layer of the superficial fascia of the abdo-

men (Scarpa's fascia) In the perineal type of extravasation the original swelling in the perineum extends to the scrotum and penis and later over the abdomen in some cases as high as the axillae. Extension into the thigh is prevented by the attachment of Scarpa's fascia to the inguinal ligament.

In the pelvic type of extravasation the point of rupture of the urethra is posterior to the urogenital diaphragm (triangular ligament) The deep layer of the urogenital diaphragm is formed by the inferior layer of the endopelvic fascia and forms the floor of the ischiorectal fossa. Anteriorly there is a definite recess below the lower edge of the gluteus maximus muscle. Rupture may occur also into the subperitoneal space from which urine may later break into the peritoneal cavity There is at first a swelling in the perineum and, as a rule, extension into the suprapubic recess.

The intraligamentous type, which follows rupture of the urethra between the layers of the urogenital diaphragm is usually considered to have a better prognosis than the other three since the extravasation is often confined within the layers of the diaphragm However it may rupture externally or internally, producing either the pelvic or the perineal type or subcutaneously with extravasation into the gluteal region.

In our series 11 were perineal three were pelvic and one was pelvic and later perineal

TREATMENT —The patient is usually desperately ill and requires prompt treatment. Often the general condition has been impaired by the antecedent urinary difficulty with attendant loss of rest and back flow of urinary products. In addition, the patient has increased difficulty in urination from the extravasation itself imminent or established uremia and severe toxemia from absorption of the products of degenerating tissue.

Free drainage of the bladder should be provided and incisions for release of extravasated urine and of necrotic tissue should be made. It is better not to waste time in attempting to dilate the already injured urethra. To do so may add just the amount of

trauma necessary to make the ending fatal Good judgment as to the type of procedure to be followed is a prime requisite for proper treatment of urinary extravasation

Diverticulum

A diverticulum is a pouch or pocket leading off from some portion of the urethra There are two varieties, congenital and traumatic, both rare They are usually situated in the posterior urethra and are the result of trauma or of softening of the urethral wall by inflammation The pressure of urine behind a stricture may enlarge the pouch The symptoms are those of urethritis Usually the diagnosis is made by urethroscopy Sometimes the patient discovers a "lump" somewhere along the urethra or in the perineum

TREATMENT —Enlargement of the neck of the diverticulum to allow drainage back into the urethra is usually all that is needed. Sometimes one must be removed surgically

Traumatisms and False Passage

Injuries to the urethra are common In a high percentage of fractures of the pelvis in the male, injury to the urethra results In such cases one must decide which is more important, the pelvic fracture or the urethral rupture Sometimes, perhaps most of the time, the injuries accompanying the fracture are so serious that all efforts must be directed toward saving the patient's life

Straddle injuries are common in boys Sometimes the injury is minor and the boy soon recovers, but later, long after the forgotten accident, stricture develops The urethra in such a case was only bruised, but infection entered and the result was a delayed inflammatory stricture

False passage is a common traumatism, resulting from unskilful urethral instrumentation A metal sound sometimes tunnels under the middle lobe of the prostate and comes out in the bladder under the trigon The urine is drawn off, but sometimes fatal damage is done In trying to pass a stricture, force is used and the point of the sound punctures the urethra, then follows along beside it, punctures

it again from the outside and re-enters the urethra. Such false passages are difficult to deal with.

Treatment is surgical.

Tumors

The commonest urethral tumors are the warty papillary growths that sometimes fill the whole urethra. They often undergo malignant change. Relatively benign papillomas on small pedicles are sometimes seen. Actual cancer of the urethra in the form of squamous cell carcinoma most frequently arises in the prostatic or membranous portion of the urethra. Leukoplakia, which is generally considered a precancerous lesion sometimes occurs, we have seen two cases.

The diagnosis of such urethral growths is generally made by the urethroscope. The treatment is surgical.

Tuberculosis

We have never seen primary tuberculosis of the urethra. Urethral tuberculosis, when it does occur, is usually part of the process of genital tuberculosis and occurs in the posterior portion of the urethra.

Syphilis

This may take the form of intra-urethral chancre which is rare, or gummatous lesions along the urethra.

Urethral Chill or Catheter Fever

This rather alarming phenomenon, also called urethral fever and urinary fever has been known for over 150 years. It results from instrumentation of the urethra. We have seen patients collapse after the passing of a sound in a urethra that was almost normal. Cases have been recorded in which the patient died of shock from the simple passing of a sound into the urethra.

The chill may occur within a half hour of the instrumentation, followed immediately by elevation of temperature to 105 to 107 F. Chills and fever may follow one another for several days, or there may be only one severe chill and a sharp rise in temperature. Some-

times the chill and fever are delayed as long as five days to a week. Most commonly, however, it comes on within a few hours of the instrumentation Such possibility makes one hesitate to pass even a soft rubber catheter in a male patient unnecessarily

The cause is not entirely clear Some have thought to explain it by attributing it to direct absorption of bacteria into the blood stream This is obviously not true, for the chills sometimes occur at once and sometimes are too long delayed Furthermore, even the smallest soft rubber catheter, that does no traumatizing whatever, may cause the most violent chill One should know the temper of the urethra before attempting to pass instruments

TREATMENT.—Administration of antiseptics before instrumentation may help, such as three or four 7½ gr sulfathiazole tablets taken in one dose about three hours before instrumentation When the chill and fever develop, hypodermic injection of ¼ gr morphine is the best treatment The chills and fever usually run a course and subside

Diseases of the Verumontanum

This small structure located at the apex of the prostate in the prostatic urethra has, in the past, come in for much outrageous treatment The disturbances of this tuft of tissue which marks the opening of the seminal ducts into the urethra are divided into three classes (1) congenital cysts, (2) new growths and (3) inflammatory lesions Congenital cysts are so rare that less than 15 cases have been reported in the medical literature, and those were all in infants New growths are equally rare, and inflammatory lesions have been all but wiped out by the use of the sulfonamides and antibiotics Men who practice excessive masturbation will always have an inflamed verumontanum Fulguration, cauterization and the application of strong silver nitrate to this delicate structure constitute meddlesome and unwarranted "treatment."

Diseases of the Female Urethra

THE FEMALE urethra is more important than its size would indicate. Its function is to guard the bladder contents and to allow the urine to flow at the will of the individual It is largely a voluntary sphincter which, though apparently weak, is quite efficient. Some times one is impressed by the small amount of sphincter left in some cases to function as a valve.

ANATOMY—The average urethra in the adult female is 1½ in. long. It is divided almost equally into three parts, each about ½ in. long by the two layers of the triangular ligament. The innermost is the pelvic or vesical portion. That which lies between the two layers of the triangular ligament is the membranous portion and corresponds to the membranous portion of the male urethra. It is surrounded by an external sphincter which corresponds to the com pressor urinae muscle in the male The terminal ½ in. is sometimes called the vaginal portion.

The lumen of this short tube is only potential. It does not stand open like a pipe or rigid tube but is normally collapsed Indeed, the tonus of its surrounding musculature keeps it in a state of normal tonicity It will readily admit a no 28-30 F sound.

The structure is similar to that of the male urethra in that the wall has three layers. The mucosa consists of stratified squamous epithelium which fades into the transitional type of the bladder in the inner or vesical ½ in. The next layer is the submucosa, which is a tough membrane supporting the mucosa. Outside of these are

the muscle coats On the inner, or vesical, ½ in of the urethra and surrounding it, and being in part continuous with the trigonal muscles, is an involuntary sphincter This is a weak muscle, but we have seen instances in which this was all that stood between patency and incontinence of urine.

The inner, or vesical, ½ in of the urethra contains no glands The middle and outer portions contain some small unnamed glands

Urethritis

Much has been written concerning urethritis in the female Although gonorrhea attacks the female urethra, and gonococci are usually found in the urethra, only occasionally is it the seat of a severe inflammation on that account Likewise, chronic urethritis as a result of gonorrheal infection in the female is rare We have examined scores of professional prostitutes, every one of whom had had gonorrhea, and have rarely found chronic urethritis A great deal of misinformation has been disseminated regarding the extent and frequency of urethritis in women Not only this, but the underlying causes have been largely misunderstood Too much has been said about cysts, glands and polypoid masses and not enough about pelvic congestion and malposition of the adnexa of the vaginal introitus

In the female urethra there are only minor vestibular glands There are no submucosal glands similar to the glands of Littré in the male urethra The outer ½ in, or outer third, of the female urethra has more glandular structures and is more exposed to infection than the inner two thirds The female urethra is said to be analogous to the male posterior urethra, but there is no prostate nor do any seminal ducts empty into it.

It is sometimes difficult to diagnose female urethritis unless one has by careful study and examination ruled out all other pathology in the urinary tract. The introitus may be so torn and relaxed by child-bearing that the bladder is pulled down to create a kink or angle in the urethra The urethra is fixed under the symphysis and when kinked at its junction with the bladder remains in a turgid

state owing to obstruction to the return flow of venous blood (It will be recalled that the veins from the urethra empty into the vesicovaginal plexus.) Any infection added to this congested condition of the urethra will result in urethritis. It is not enough there fore, to direct treatment toward the urethra itself The introitus must be restored as nearly to normal as possible When that is done, many patients recover without further local treatment.

Stricture

Considering the fact that as many women as men have gonorrhea, stricture of the female urethra is extremely rare. The so-called strictures of large caliber are apocryphal they do not really exist.

FIG. 94.—Typical granuloma inguinale in women. Both were cured with tartar emetic intravenously

We have seen a large number of women with various urinary complaints but have not seen more than 25 with strictures. Not all of these produced symptoms. By stricture we mean a contracture of the urethra so small that only a filiform can enter its lumen. It has been shown that the average caliber of the normal female urethra is 22 F., meaning an inside circumference of 22 mm. The complaint with most urethral strictures is difficulty in emptying the bladder The patient states that it takes too long to empty

We had one patient with a filiform stricture of the urethra who

had a left kidney colic due directly to the stricture When the stricture was dilated the pain in the left kidney disappeared, but recurred as soon as the stricture was neglected by the patient So much damage was done to the upper urinary tract by this stricture that hypertension and chronic nephritis finally developed and she died

Granuloma inguinale (Fig 94) and lymphopathia venereum sometimes cause stricture of the urethra

TREATMENT.—The treatment of stricture of the female urethra is dilatation The urethra is first anesthetized by placing metycaine powder directly in the urethra and up to the stricture Five cubic centimeters of 2 per cent metycaine solution is then injected through the stricture with a blunt-nosed bulb syringe A filiform is passed into the urethra through the stricture, followed by a bougie that has been screwed on the filiform The dilatation should proceed slowly and carefully At the first treatment the dilatation should not be greater than 16 or 18 F, a higher caliber may crack the stricture and make it bleed The procedure should be carried out once a week until the urethra will accept a no 30 F sound After that the urethra should be dilated every six months, for these strictures have a tendency to recur

Diverticulum

While this is rated as rare, we have found diverticulum of the female urethra more common than stricture We believe that many of these cases are overlooked There is considerable disagreement concerning the origin of this outpouching from the female urethra, one group favoring the acquired and the other group the congenital theory of origin We believe all are congenital In support of this theory, one may point out that instances are found in female babies Those who favor the acquired theory cite cases to show that the diverticula are often multilocular This, of course, differs from diverticula in other areas

The diverticulum usually extends from a small opening in the

floor of the middle portion of the urethra, readily seen with a urethroscope. We have never seen a diverticulum associated with stricture of the urethra.

DIAGNOSIS.—In most cases the diagnosis is urethritis, and we have seen cases in which the urethra was cut and burned with no curative result. The lesion must be suspected. Generally the woman complains that the pus exudes from the urethra. The examiner should place the index finger in the vagina and press upward against the urethra. If a rounded, cystlike mass is felt below the urethra and a large quantity of pus exudes from the urethra, diverticulum should be suspected. The next step is visual confirmation through the urethroscope.

TREATMENT.—This is by surgical excision. The tissue removed should always be subjected to a pathologic examination.

Prolapse

This means a protrusion or eversion of the mucous membrane of the urethra through the urethral meatus. It is commonly confused with urethral caruncle. Prolapse occurs in various degrees. The commoner ones are mild. Only a small portion prolapses and appears as a small strawberry like protrusion on the posterior lip of the meatus. This is the type misdiagnosed urethral caruncle.

Prolapse may be divided into three degrees. (1) In the first degree the urethra is somewhat relaxed and a small amount of urethral mucosa protrudes as a small reddened eminence on the posterior lip of the external urinary meatus. (2) In the second degree, there is a considerable cuff of the urethra protruding through the urinary meatus as a reddened ring. The protrusion may be as much as 5 mm. (3) In the third degree, there is a large fixed cuff of urethral mucosa protruding from the meatus. It is markedly inflamed and usually painful. The whole trigonum, with the ureteral orifices, may protrude through the urethra.

ETIOLOGY.—This is a fairly common lesion. There must be, first

of all, relaxation of the urethral sphincter and the tissues surround-ing it The mucosa is not as securely attached to the urethra as in normal individuals Bladder paralysis, with partial or complete paralysis of the urethral sphincter, predisposes to this condition When such relaxation or paralysis occurs, prolapse may take place in any of the three degrees The first degree prolapse usually has a gradual and insidious onset The second and third degrees may appear suddenly after an accident, such as a blow on the abdomen, diarrhea in which there is much straining, and cystitis with strangury and tenesmus Curiously, it rarely occurs during the child-bearing age Sixty per cent of the reported cases have been in children In our experience, it is much commoner in persons past 60

DIAGNOSIS —Recognition of the disease should be simple if ade-quate inspection is made under a good light

TREATMENT —The treatment is surgical

1. In first and second degree cases, the prolapsed mucosa is easily replaced but will not stay The procedure is to replace the mucosa first. Then a midline incision is made on the posterior part of the urethra, exposing the sphincter fibers Fine chromic catgut sutures are taken, tightening the sphincter These sutures include the mucosa so that when the stitches cut through, healing will follow and the resultant scar will cause the mucosa to adhere firmly to the urethra The vaginal wall is then closed, using a mattress stitch of silk, standing the two raw surfaces in apposition Two silk sutures should be placed so that they include a bite in the urethra They are secured over a roll of gauze and drawn down rather snugly They slowly cut through and heal behind so that again an adhesion is formed to anchor the urethra securely in place

2 When the prolapse cannot be replaced, four mattress silk sutures are placed, starting from the outside toward the center, then out again The tie is made on the outside of the cuff The four sutures are placed at 12, 3, 6 and 9 o'clock. The cuff is then cut off with the high frequency knife The bleeding points are coagu-

lated and a sulfonamide powder vaseline dressing is applied. Later a tightening operation on the sphincter may be done

Tumors

Tumors of the urethra fall into two groups benign and malignant.

The benign are by far the most common. Examination of the urethra with a direct vision cystoscope or a McCarthy panendoscope sometimes reveals a fringe around the internal urinary meatus, called polyps by some urologists. They are really only inflammatory tags and frequently disappear when the inflammation subsides. When "burned" off with the high frequency electric current, they often recur It is best to leave them untreated. They are not neoplasms.

Some solid tumors have been reported. These consist of fibromas, fibromyomas and leiomyomas. They are exceedingly rare.

The most important and common tumor is the so-called urethral caruncle. This is a small strawberry like growth springing usually from the posterior part of the urethra. The external third of the urethra is the only portion that harbors them. These growths may also spring from the sides of the urethra, and may spread deeper into the urethra. They are composed of loops of blood vessels and bleed readily when touched. They generally appear in women over 30 In about half the cases the patient is unaware of anything in the urethra until she looks at it with a mirror

Microscopic sections of these growths disclose two general types, (1) the papillomatous, which is commoner and (2) the angioma tous. The papillary type has a supporting connective tissue frame work and is covered with transitional or stratified squamous epi thelium. These growths rarely remain clean their position subjects them to infection. Infection added to this soft mass of looped blood vessels causes them to increase in size owing to the inflammatory reaction. The angiomatous type is composed largely of blood vessels without much supporting connective tissue stroma.

SYMPTOMS—In the 50 per cent who have symptoms, the complaint is burning and pain in the urethra on urination There may be only bleeding Occasionally these caruncles undergo malignant change, but this is infrequent

The diagnosis should be easy but should not be confused with prolapse (p 327)

FIG 95 —Condyloma acuminatum, or venereal warts, in a young woman

TREATMENT—This is surgical It is a simple office procedure if certain principles are understood

The tumor is vascular and springs from a vascular area A local anesthetic is necessary Infiltration of the area around the urethra with a small amount of ½ of 1 per cent novocain hydrochloride is satisfactory The needle is inserted at four points 12, 3, 6 and 9 o'clock For small growths, a small amount of metycaine powder applied directly to the caruncle and the urethral mucosa is sufficient We have abandoned all methods of fulguration and coagulation in

preference for a fine cautery The growth is gently picked up with a pair of Allis forceps to expose the base, and the fine point of the cautery is used to cut the growth free. The base is burned down lightly and all reddened areas are likewise cauterized. To get at the deeper areas in the urethra, a skeneoscope is useful.

No matter how thoroughly or how carefully these caruncles are removed, many of them recur We have found it necessary to see the patient at two week intervals for about three months At these office visits, the urethra is inspected and the fine cautery used to burn any red spots that remain. If this is done when the mucosa again returns to a normal pink color there is no danger of return

Nervous or apprehensive patients may require hospitalization and use of a general anesthetic for the surgical removal of the caruncle. Caustic treatments, such as silver nitrate application, do no good whatever

Warts seldom become a urethral problem, although they frequently occur around the vulva (Fig. 95)

Carcinoma

Malignant growths of the urethra are fortunately not common. Probably a few more than 200 cases have been reported in the literature

SYMPTOMS.—The symptoms are those of obstruction of the urethra. The growth is generally painless. Late in the disease, however there are much pain and discomfort. Infection sometimes complicates the condition and may mask it so that at first the diagnosis is not apparent. Sometimes a lump or tumor is noted by the patient. In some instances blood in the urine is the first sign.

DIAGNOSIS.—This should be made by inspection and palpation. Prolapse of the urethra, if of third degree, sometimes resembles a fungating cancer and a large urethral caruncle may simulate a malignant growth. Sometimes a biopsy study is necessary to establish the diagnosis. At any rate, all tissue removed should be examined by a pathologist.

PATHOLOGY —The pathologic structure of malignant tumors of the urethra depends on the nature of the tissue from which they spring.

1. Malignant papillomas arise directly from the mucosa of the external third of the urethra. They may occasionally be derived from simple caruncles that have undergone malignant change

2 Squamous cell epitheliomas arise from the mucous membrane of the urethra. They are the commonest tumors of the urethra.

3. Adenocarcinomas arise from Skene's glands or from the tiny glands that are thought by some to be homologues of the glands of Littré in the male Some tend to be of mixed form, having both mesoblastic and ectoblastic elements

4. Pure sarcomas are rare, but when they do occur they arise from the mesoblastic structures

TREATMENT.—Treatment is surgical excision. As elsewhere in the body, when dealing with malignant tumors, early recognition is important.

Because of the vascularity of the area involved, the high frequency electric cutting current is useful Excision can be performed with less blood loss and bleeding can be controlled much more satisfactorily than by any other method. After the growth is excised and all bleeding points are sealed it is necessary to divert the urine by means of an indwelling urethral catheter Radium or roentgen therapy, or both, may be used but the results are not too good.

Anomalies

Anomalies of the female urethra are rare, occurring not oftener than once in 200,000 female births Absence of the urethra was made the basis of a study in 1936 by Stevens, who could find only seven cases in the literature.

Congenital valves or diaphragms, not exactly analogous to those found in the male, are found in the outer third of the urethra near the meatus They also are rare, less than 15 cases being recorded.

Congenital stricture of the female urethra is rare, but Campbell

states that it is almost as common in girls as in boys. We have seen
no case of congenital stricture of the female urethra in our fairly
long experience.

REDUPLICATION—Double urethra is a rare anomaly It is almost
analogous to double penis in the male. Not over six cases have been
recorded.

HYPOSPADIAS.—This is a defect in which the posterior part of
the urethra is deficient. It is analogous to hypospadias in the male
but is much less common.

EPISPADIAS.—This anomaly is practically nonexistent without
exstrophy of the bladder of which it is always a part.

Injuries

The female urethra is subject to trauma in childhood from strad
dle injuries. Many strictures of the urethra in females in later life
can be traced to childhood straddle injuries. Childbirth adds its toll
of injuries to the urethra. Sometimes injury is done to the urethra
during coitus. In fractures of the pelvis, the female urethra is seldom
injured.

Fistula

Communication between the urethra and the vagina frequently
occurs. This type of fistula causes no disturbance if located in the
middle or outer third of the urethra and need not be repaired. If
however the fistula arises in the inner third of the urethra, there
is apt to be loss of urine, and such a fistula needs careful repair

significant Obesity may not cause infertility, but its basis should be sought out to determine whether endocrine abnormalities or just plain overeating is responsible

The woman's age is of considerable moment The age of maximal fecundity varies with different races but usually reaches a peak before 25 and diminishes thereafter In the Latin races development is earlier and maximal fruitfulness is reached at an earlier age In northern peoples the opposite is true

EXAMINATION —A general examination should precede a pelvic examination Many apparently unrelated findings should be jotted down The temperature, pulse rate and blood pressure should be recorded Examination of the blood should be complete, with hemoglobin determination and red and white cell and differential count Examination of a catheterized specimen of urine should be carefully done If there are any abnormal findings, repeated examinations of the urine should be made The blood Wassermann test should not be overlooked, and in some instances it is important to make spinal fluid studies When these observations have been incorporated into the record, a pelvic examination should be done

PELVIC EXAMINATION —The introitus should be carefully examined The presence of scars or of pus in small quantities exuding from Skene's and Bartholin's glands needs explanation The condition of the urethra, whether normal pink color or congested and reddened, may be an important index One will, of course, note whether or not there is an abnormal amount of secretion from the vagina Next, a speculum of the bivalve type is introduced and the cervix inspected The appearance of a normal cervix should be well known to every physician The finding of an abnormally small or almost pinpoint cervical os is of considerable importance A ropy secretion exuding from the cervix means trouble higher up in the uterus Smears should be made from the cervical secretion and studied for the type of bacteria The presence of trichomonas should be especially looked for This inspection of the vaginal vault and

cervix completed, the next step is manual examination of the pelvis.

One must determine the size and shape of the uterus using one hand in the vagina and the other on the abdomen. The uterus may be found to be smaller than normal, yet not infantile in type. Such a small uterus does not predispose to infertility An abnormally large uterus calls for careful consideration. The first thought in such a case is to rule out pregnancy After that, inflammatory reactions, tumors such as fibroids, and malignant disease should be considered. There may be malposition of the uterus. This may take the form of anteflexion or retroflexion. Such displacements predispose to sterility but it is to be understood that if the uterus is otherwise normal malposition alone is not an absolute bar to pregnancy Palpation of the tubes and ovaries may reveal various types of inflammatory disorders. If the tubes are thickened and tender it is impossible for pregnancy to take place This, however, has notable exceptions, for we have known women who conceived despite acute gonorrhea with pelvic inflammation. Sometimes only one tube is thickened and tender and the other tube is found on palpation to be perfectly normal. The tube of normal consistency may, however, have recovered from the inflammation and may be already sealed.

The ovaries should be carefully disclosed by bimanual palpation. If they are of normal size and consistency on palpation they are probably normal. If either one is enlarged this does not prove sterility Only one good ovary is essential to fertility

Granted, then, that a thorough physical examination has revealed no systemic disease no endocrine disorder no syphilis or gonorrhea, and that as far as can be told by examination of the pelvic organs there is no cause for sterility the next step should be the special tests.

There are two tests of importance (1) the Huhner test, and (2) the Rubin tubal patency test.

THE HUHNER TEST —It is to be emphasized at the outset that no one test is final in determining fertility or sterility In 1913 Max Huhner wrote a book on *Sterility in the Male and Female* in which

he proposed a simple test for fertility This has since been known as the Huhner test and adopted as a standard all over the world

The necessary apparatus for carrying out the test include a microscope with substage lamp, clean glass slides, coverglasses, a long pipet fitted with a small rubber bulb, a Keyes silver instillator type of cannula onto which is fitted a 2 cc Luer syringe, bivalve speculum and several tightly wound cotton applicators on wooden sticks

TECHNIC

1   The woman comes to the office as soon after coitus as possible She uses no plug of cotton or anything else to retain the semen She should be told not to use any lubricant of any sort

2   She is at once placed on an examining table in the regular gynecologic position

3   A bivalve speculum is inserted, using no lubricant

4   A clean glass pipet, on which has been mounted a small bulb (such as used on the ordinary bulb syringe), is inserted gently into the cervix and some of the secretion aspirated (We use a Keyes silver urethral cannula which has been slightly straightened and connected to a 2 cc Luer syringe)

5   This secretion is placed on a clean glass slide, covered with a cover slip and examined at once under the microscope for spermatozoa This completes the test

Huhner further added that the cervix is next to be wiped off with a gauze sponge and some of the material within the internal os obtained This specimen is then examined under the microscope for spermatozoa Furthermore, a wooden cotton wound applicator is inserted into the cervix and the cervix cleaned by a twisting motion The cannula is then inserted carefully into the uterus above the internal os and the secretion obtained examined at once under the microscope for spermatozoa

Evaluation of the Huhner Test —Many women do not wish their husbands to know that they are being investigated for fertility As

Huhner pointed out, his test is at once a test of fertility of the male and the female. If well formed, lively sperms are found in both vagina and cervix, the husband is not sterile.

It matters not that the patient says she does not enjoy sexual relations, that she has no orgasm, that her husband is too quick, being of the nervous type who has premature ejaculation. It makes no difference if the husband has epispadias, hypospadias, a small penis or other deformity; proof is at once at hand that he can deliver spermatozoa to the right place. The complaint that all the secretion runs out of the vagina at once after intercourse makes no difference.

The chemical reaction of the vaginal and cervical secretions is normal if live spermatozoa are found in the vagina and cervix, and no further tests of them need be done. If live spermatozoa are found in the fundus of the uterus, it does not matter that the woman has an anteflexion or a retroversion. The sperms may travel as far as the fundus, yet the tubes may be sealed so that they cannot meet the ovum.

If no live spermatozoa are found in the vagina, cervix or fundus by the Huhner test, the male must be examined.

One other portion of the female sexual anatomy needs to be examined—the fallopian tubes. On their patency may depend final decision whether the woman in question is sterile.

TUBAL INSUFFLATION TEST—In 1920, I. C. Rubin of New York City devised a test for tubal patency. Before that time the only way the fallopian tubes could be tested was by opening the abdomen and threading a fine filiform down through the tube. Rubin's test consists simply of causing gas to pass through the uterus and out through the fallopian tubes into the peritoneal cavity. By roentgenograms made in connection with the test, the pneumoperitoneum can be demonstrated beyond question and the patency of the tubes established.

Apparatus for the Rubin test include a speculum of the bivalve type, uterine sound, dressing forceps or sponge holder, tenaculum

a silver cannula with a conical end which will fit into the cervix, a Luer hub and one-way stopcock, a metal T-tube, a manometer or pressure gage (the one off the blood pressure apparatus is ideal), cotton balls, weak solution of tincture of iodine and the bulb from the blood pressure apparatus
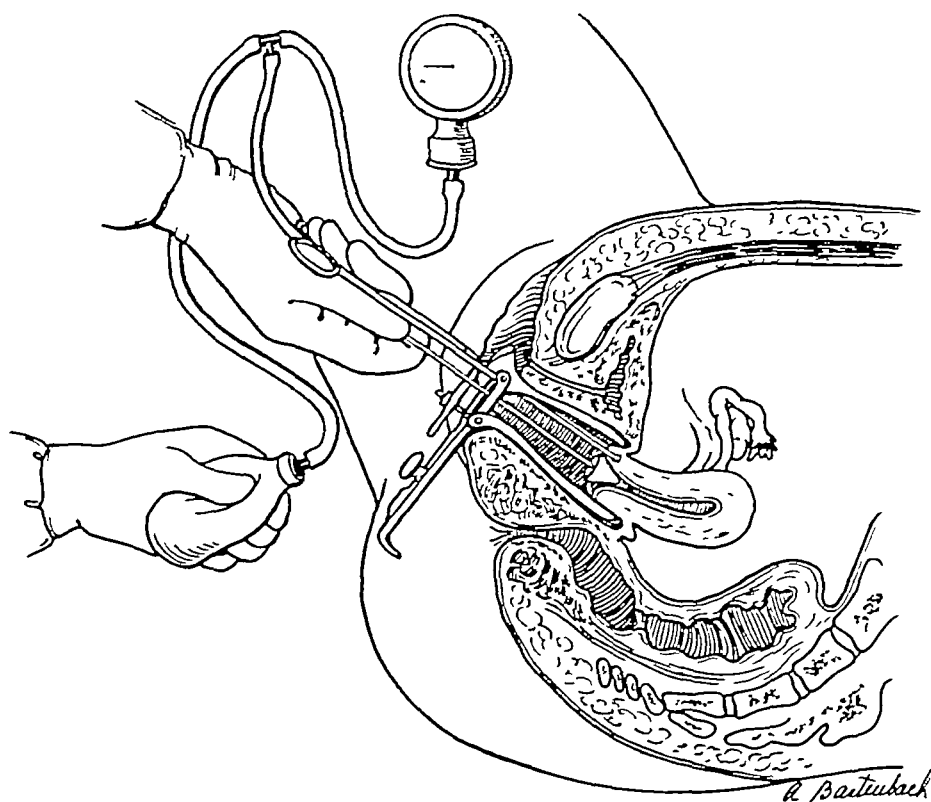
FIG 96—Rubin insufflation test.

TECHNIC

The test should be done between the menses, preferably eight days after the last day of the period The apparatus should be set up and tested (Fig 96) The vagina is cleansed, a bivalve speculum introduced, the vagina dried and the cervix and vaginal walls painted with the weak tincture of iodine With the tenaculum, the upper lip of the cervix is grasped and pulled outward The cannula with the conical tip, sterilized, is inserted in the cervix and pressure

made against it to form a firm union or joint between the conical tip and the cervix so that no air can leak around it. With everything set up properly the next step is to pump air into the uterus through the cannula. The pressure gage must be watched closely The pressure slowly mounts until the needle indicates 80 mm. Hg A sudden drop of pressure at this point, accompanied by a hissing sound, indicates that the tubes are patent. If the pressure steadily mounts to 120 or 140 mm Hg with no sign of air entering the abdomen, the tubes are probably sealed. If the pressure can be raised to 190 to 200 mm. Hg one can be almost sure that the tubes are sealed.

The air passing into the peritoneal cavity through the tubes often causes pain in the shoulder Some advocate having an assistant listen for the hissing sound over the abdomen with a stethoscope. The hissing sound from leaking around the cannula as it is attached to the cervix is picked up on the stethoscope and may be misleading.

All apparatus are disconnected and removed and the patient is brought to the x ray room for fluoroscopy The gas can be seen in the spaces under the diaphragm when the patient is in the upright position. Fluoroscopy is not absolutely essential but it makes the results doubly sure when the gas is seen collected in the subphrenic spaces and helps in the evaluation of the negative cases, which are always more difficult. Sometimes with the pressure of 200 mm. Hg some of the gas passes into the peritoneal cavity and can be detected only by roentgen rays.

Tubal obstruction is far more common than is generally believed. In nearly 100 000 Rubin patency tests it has been found that 30 per cent were not patent and 8 per cent were partially obstructed

There are only a few contraindications the presence of infection or inflammation, tumor or other pathology is a definite contraindication to the test.

OVULATION —Sometimes ovulation does not take place, so there is no ovum for the spermatozoa to impregnate. During ovulation there is found in the urine in increased amounts an excretory substance derived from the corpus luteum called pregnandiol A test

to whether the woman ovulates or not is based on the estimation
pregnandiol in the urine Either anovulation or irregular ovula-
in may be determined in this manner The test must be carried
t in specially equipped laboratories

Sterility in Men

Just what percentage of childless marriages is actually due to
rility may never be known There are today many unfruitful
irriages in which either husband or wife, or both, refuse to assume
ȝ responsibilities of parenthood
The physician is usually first consulted by the wife because of
ildlessness The doctor examines the woman and can find no
ise for sterility It is then that the husband is called for question-
ȝ It was formerly believed that sterility was rare among men
cause it was assumed that if the man could have normal sexual
ationships and had a normal orgasm he was fertile Sterility and
potency are not the same thing A male may have no sperms
d therefore be sterile, but not impotent On the other hand, a
in may be impotent and for that reason be unable to copulate,
t have an abundance of viable spermatozoa
We suggested earlier in the chapter that probably the blame for
rility rested about equally on husband and wife This might be
erpreted as meaning that the wife was at fault one third of the
ne, the husband one third of the time and both one third of the
ne Granted that the female is perfectly capable of being impreg-
ted, it is necessary that the male be able to produce large numbers
healthy spermatozoa and that he deliver them to the female cervix
EXAMINATION —The first step, therefore, in the study of the male
to examine the ejaculate Condom specimens are the easiest to
tain and are most convenient for the patient The condom must
carefully washed inside and out with soap and water, rinsed and
refully dried before it is used by the patient for collection of the
ecimen This is to prevent death of the sperms from powder or
essing in the condom If no sperms are found in the condom

specimen, or the spermatozoa are not perfect in the spermatic fluid, another specimen must be collected in a sterile large glass test tube or bottle with a wide mouth The man withdraws just before ejaculation and catches the semen in the glass tube or bottle The specimen is brought in for examination as quickly as possible because of the effect of time on the spermatozoa and because spermatozoa degenerate quickly in the open air owing to the presence of oxygen.

We are enormously indebted to the studies on animal spermatozoa carried on in our various agricultural colleges and aquariums. A great fund of knowledge of the natural history of animal spermatozoa has been accumulated, much of which applies directly to the problem of human sterility and fertility Most animals of the higher order have seasonal variations in fertility and this may also apply to man in a lesser degree. Not enough information can be obtained by simply placing a drop of semen under the microscope to see if motile sperms are present. The examination must be much more comprehensive and should proceed as follows

1 *Measurement of Amount or Volume of Total Ejaculate* —This is done in a graduated glass measuring cylinder of 10 cc. capacity The amount of total ejaculate varies from 0 4 to 7.8 cc.

2. *General Physical Appearance of the Specimen* —When semen is freshly formed it is viscid and jelly like. In a few minutes it begins to undergo lysis or self liquefaction. Viscosity can be measured roughly by using two tongue sticks and pulling them apart when moistened in the semen. Liquefaction is normal a persistent jelly like state is abnormal. There is a characteristic pungent odor about semen.

3 *Reaction or pH* —The reaction is always alkaline This varies from a pH of 7 5 to 9 0 The testing can be done by the nitrazine paper strip method (see p 21)

4. *Microscopic Examination* —The form shape and general morphology are studied by means of stained specimens. A preliminary examination of the fresh specimen should be made by means of a drop placed on a slide with a coverslip placed over it. In place of

this or in addition, a hanging drop preparation may be made If only a few sperms are seen, a small portion of the ejaculate should be centrifuged and the precipitate examined One should observe the motility of the spermatozoa, their uniformity as to size and variations in shape (Fig 97) Note should be made as to the shape of each portion of the spermatozoa, the tail, middle piece and head.
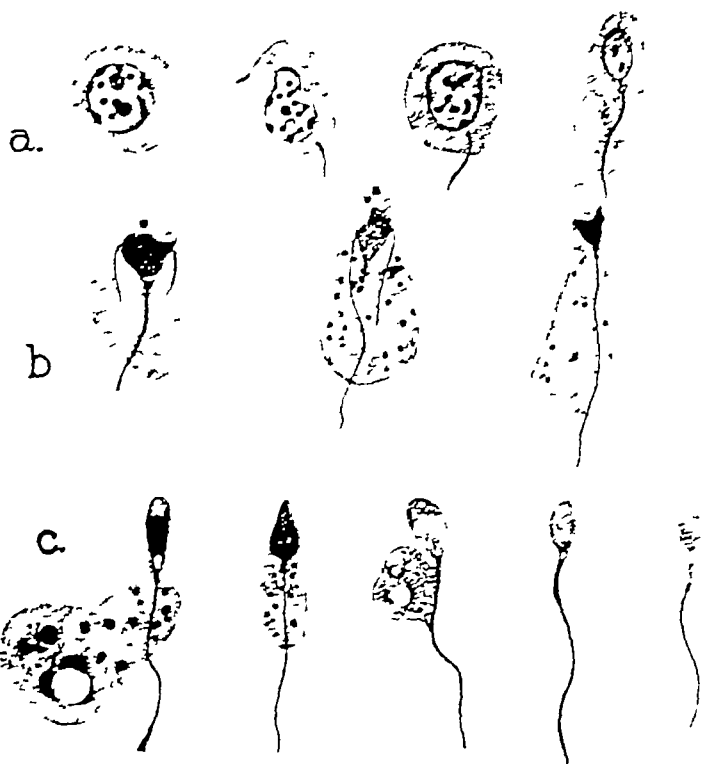
FIG 97 —Formation of a spermatozoon, showing various stages (From Hinman, *Principles and Practice of Urology*, Saunders, 1935, p 148)

In counting the spermatozoa, use the same pipets and counting chambers as for blood cell counting The diluting fluid can be made up in a stock solution. This consists of

Sodium bicarbonate   .   .   5 Gm
Formalin solution, 1 per cent   100 cc.
Dissolve and place in a labeled bottle

This acts at once as solvent for the small amounts of mucus present and immobilizer for the spermatozoa. A small amount of the semen

is taken from the main supply In this, the blood-counting pipet (1 20) is dipped and the liquefied semen is drawn up to the 0 5 mark. Next the tip of the pipet is dipped in the diluting fluid and solution drawn up to the 11 mark. This makes a 1 20 dilution. The pipet is shaken as in blood counting and the amount in the capillary lumen discarded. A simpler method of diluting the semen for pur poses of counting is to use a graduated 25 cc. cylinder With a graduated pipet, exactly 1 cc. of the semen to be examined is drawn up and placed in the graduated cylinder The cylinder is then filled to the 20 cc. mark with the diluting fluid and shaken well to mix thoroughly This, of course, is a 1 20 dilution.

Next the coverglass is placed on the ordinary Neubaur counting chamber and exactly the right amount of diluted semen is placed on the counting squares. The spermatozoa are allowed to settle down, then the counting chamber is carefully placed under the low power objective of the microscope. All the sperms seen in 1 sq mm. are counted and the total is multiplied by 20 the dilution. The cal culation therefore is Number of spermatozoa in 1 sq mm $\times$ the dilution (20) $\times$ the depth of the counting chamber (10) — the number of sperms in 1 cu. mm. of semen. This number times 1 000 equals the number of sperms in 1 cc The amount of the total ejaculate having been measured, the number of spermatozoa per cubic centimeter $\times$ the volume in cubic centimeters — the total number of spermatozoa in the whole of the semen ejaculated.

There is a wide normal variation in the number of spermatozoa per cubic centimeter Observers who have examined the ejaculate of hundreds of men have observed variations which range from 15 000 000 to over 900 000 000 per cubic centimeter The number of spermatozoa in 5 cc. of semen is almost astronomic, reaching 4,500 000 000 in some instances.

TECHNIC OF STAINED SMEARS

There are several good methods of staining spermatozoa, although none is simple. It is more difficult than staining blood smears.

After the semen has liquefied a small drop from a fine pipet is placed on a clean slide With the edge of another clean slide the smear is made The smear should be quite thin The smear is dried by putting it on the top or lid of a hot electric sterilizer for a few seconds to one minute or by gently heating over a Bunsen burner Some workers who used an oven at 150 C to fix the smear to the slide state that it is difficult to fix the slide without an oven

Meaker suggests a method which he and his colleagues use

1 Fix the smear with heat

2 Wash with 0 5 per cent chlorazene to remove the mucus

3 Wash in clean water

4 Dip in 95 per cent alcohol and dry

5 Stain for one minute with a dye that is a mixture of fuchsin and bluish eosin (carbolfuchsin 2 parts, bluish eosin 1 part and 95 per cent alcohol 1 part)

6 Wash in water

7 Stain for one minute with methylene blue (methylene blue 1 part, distilled water 4 parts)

8 Wash again with water, blot with a clean blotter and dry

The slide is now ready to be viewed under the microscope It can be studied under the high power dry lens or under the oil-immersion lens, as desired The stain produces excellent contrast for studying the different parts of the spermatozoa—the head, the middle piece and the tail

We have learned a great deal concerning human spermatozoa during the past 20 years, probably more, in fact, than in all the centuries since van Leeuwenhoek The barren centuries were punctuated by the work of the great Swedish anatomist, Magnus Gustaf Retzius, whose studies in comparative spermatology are still the most comprehensive ever made on the subject There are many things yet to be learned concerning human spermatozoa, but we will briefly enumerate some of the known facts

1 Spermatozoa are provided with glucose in the semen, which supplies their life energy When the supply of glucose is exhausted

they die. Spermatozoa have been kept alive for nine days in buffered Tyrode's solution in glucose adjusted to pH 7 4.

2 Spermatozoa show a high resistance to cold and a low resistance to heat. Experimental evidence shows that at −196 C. spermatozoa survived when examined 52 hours later Spermatozoa were subjected to a temperature of only 4 degrees warmer than absolute 0 C., and some of them survived. At body temperature (37 C.) and up to 45 C. spermatozoa die rapidly The reason assigned for this is that the spermatozoa use up their supply of glucose much more rapidly at the higher temperatures and so die of lack of nourishment.

3 Experimental and clinical evidence shows that an abdominally retained testis becomes sterile because of the slight increase in temperature within the abdomen over that of the testis in its normal position in the scrotum.

4 As is to be expected, under adverse circumstances such as change to acidity from alkalinity or to heat from cold, defective spermatozoa die first. The semen of the average man usually contains 10-20 per cent of abnormal immature or defective forms.

5 Spermatozoa do not tolerate oxygen. They are for all practical purposes anaerobic.

6 Although there is some controversy, women apparently have been made sterile by immunizing them against spermatozoa. This is done by subcutaneous injections of spermatozoa.

7 In necrospermia it has been found that there is a difference between the (a) dead spermatozoa which died after being ejaculated and (b) those that were dead when ejaculated. Those that belong to the first class (a) have tails outstretched straight, and those in the second class (b) have tails curled up or bent, as in spiral form.

Sometimes a young man who is about to be married becomes worried and desires to know if he is fertile. In such a case we are opposed to giving the young man a condom and asking him to go out and have intercourse with a strange woman and bring in a

specimen Nor would we countenance masturbation to obtain a specimen Examination of the prostate and external genitalia, as well as his appearance, may convince the doctor that there is no doubt concerning fertility Spermatozoa can sometimes be obtained by massage and stripping of the seminal vesicles with the gloved finger through the rectum The young man is told to wait five to 10 days following a nocturnal emission before coming for this test At that time the vesicles will be full Sometimes we have had success by giving the young man a test tube to keep beside his bed If he has a nocturnal emission, he is to try immediately to collect some of the ejaculate in the test tube, cork it and bring the specimen to the office the next morning The presence of spermatozoa in this specimen settles all arguments

One must not be unmindful of the fact that sperm viability and potency probably change for better or for worse at some time in every normal male By that we mean that a specimen or a series of seminal specimens may be examined and found to be full of deficiencies as to both form and number A poor prognosis is given, only for us to find that we were mistaken when, without treatment, the man impregnates his wife

Some men with spermatozoa of good form and in good number are unable to impregnate a woman who is known to be perfectly normal and fecund This comes under the heading of male fecundity It is probable that in these cases the spermatozoa lack the vital flash to cause them to penetrate the ovum successfully On the other hand, the ovum may have some repellent substance toward the spermatozoa of that particular male

TREATMENT OF MALE STERILITY —There are two main groups of sterile males (1) those who have spermatozoa in the semen, and (2) those who have azoospermia, or absence of spermatozoa in the semen

1 *Infertility with Spermatozoa in the Semen* —The etiologic factor should be determined, if possible General health should be restored if it is in any way impaired Inquiry should be made re-

garding business worries, alcoholism and other dissipation. Rest in a quiet place away from home should be advised

Sexual habits must be investigated particularly whether sexual relationship is satisfactory. Sometimes there is no sexual contact, as when the wife has an orthopedic deformity that prevents satisfactory coitus. How often is copulation carried out? If every day as is sometimes the case there will be depletion of the number and viability of the spermatozoa. A period of abstinence of about two weeks may be recommended, then have the couple come together but at a time when both are rested and care free

If the patient is overweight reduction should be gradual with no drastic cut in food intake. The average weight, according to standard age weight height tables should be maintained. Vitamin C should be given in the form of orange juice or a synthetic product such as cevalin tablets (Lilly) or it may be given intravenously 100-500 units daily. Vitamin E is said to be important according to animal experiments, but it is not known to be applicable in human sterility

Testosterone propionate may be given cautiously in 5 mg doses three times a week, in oil soluble form obtainable as perandren or oretone. Care must be exercised in giving this substance for in certain instances it decreases the number of spermatozoa in the semen. The decrease is largely due to overdoses when 25 mg doses are given daily the number of spermatozoa is definitely decreased. Careful sperm cell counts must be done every week to determine progress.

Thyroid extract may be given in $\frac{1}{4}$ to 1 gr doses daily. Here again care must be exercised. For some persons, this is an extremely small dose. If no effect can be noted such as rapid pulse, feeling of nervousness or sleeplessness the dose may be increased. If however untoward effects are noted, thyroid extract should be discontinued.

Infections in the prostate must be cleared up (see Chapter 14 for treatment)

Treatment should continue for 60 to 90 days Favorable results should be obtained in that time both as to the infection and as to increase in spermatozoa

2 *Infertility with No Spermatozoa in Semen* —The commonest cause for this condition is an obstruction of some of the various ducts which carry the spermatozoa and the semen to the outside The obstruction may be in the epididymis, vas, seminal vesicles, ducts leading into the posterior urethra or the urethra in the form of stricture Correction of the obstruction is sometimes easy, sometimes difficult If a stricture is present in the urethra, passing a filiform followed by a sound will relieve the difficulty Sometimes operative measures in the form of anastomosis between vas and epididymis will cure

Before any operative measures are undertaken, it is necessary to determine whether or not the spermatogenic apparatus in the gonads produce viable spermatozoa This can be done by testicular puncture or testicular tap

TECHNIC OF TESTICULAR PUNCTURE

It is necessary to puncture both testicles only if the first tap shows no spermatozoa

The assistant gently forces the testis to the bottom of the scrotal sac and holds it there so that it is tightly impinged against the coverings A small spot on the scrotum over the testis is painted with weak iodine solution A small wheal is made using ½ per cent procaine solution A 2 cc glass syringe is fitted with a no 17 Luer needle and this needle is plunged quickly into the center of the testis Aspiration is begun at once (it is important to see that the inside of the syringe and barrel are wet) and maintained strongly while the needle is slowly withdrawn The point of the needle is put down at once on a clean slide, the aspirated material expelled, a coverslip placed over it and the material examined at once under the microscope If no spermatozoa are seen, further slide preparations are made until some are found or until the aspirated material is exhausted When found, the spermatozoa are not nearly

as motile as those seen in spermatic fluid. Even if they appear dead, this generally means they are immature

Some physicians prefer testicular biopsy In this, a small piece of tissue is cut from the testis and examined. When spermatozoa are thus found in the testes but none appear in the semen, surgical intervention in the form of anastomosis of the vas to the epididymis may be successful.

If no spermatozoa are found on testicular tap or testicular biopsy, the patient is hopelessly sterile. It is wise not to be too abrupt in making such an announcement to the barren couple, for dire results may follow Separation of the couple may be the result, to say nothing of the possibility of self-destruction in a fit of despair

Impotency

Impotency means inability to perform the sexual act. This may be either partial or complete. Volumes have been written on this subject, and the causes are as varied as any in all the realm of medicine. Most cases fall into the functional or psychic classification. A few are due to such disorders as paralysis from spinal cord injury spinal cord tumor and spinal cord disease such as tabes. Some of the psychic cases are brought on by excessive sexual relationships.

Masturbation is a frequent source of impotency We have had a number of cases in which the patient could bring about erection and ejaculation by masturbation but could not obtain an erection for sexual intercourse

Many men suffer from premature ejaculations. These individuals no sooner have an erection and start to copulate than they have an ejaculation. This form of impotency is entirely a psychic manifestation.

There are strange variations of impotency We have many patients in our practice who are perfectly normal and strong sexually with certain women, whereas with other women with whom they greatly desire to have sexual relations they are completely

unable to have an erection It is not uncommon for a man to lay siege to a certain woman whom he greatly desires After a long time, she finally yields He is so overcome with the desire to please her that for some reason overstimulation takes place and try as he will he cannot have an erection

A recitation of these psychic states could be endless, but they are common in the experience of every physician The physician's good judgment is tested in these cases for, while the cause is generally psychic, the cure is not always simple

TREATMENT —Impotency may be a cause of sterility Probably those who complain the loudest are the younger men who suffer from this malady This younger group is mostly composed of men who are partially impotent Some are married, some unmarried In any event, it is important to go thoroughly into the history of the case

In practically all cases in unmarried men, the advice given by the doctor can be rather simple, concise and final These men are told that they need sexual rest They are told to practice continence Above all, the physician should not pass sounds, inject irritating chemicals or give various sex hormones or other stimulating drugs or chemicals The urethra, prostate, seminal vesicles and gonads are all in a stage of congestion from overstimulation in these cases Rest, in the form of continence, temporary avoidance of the society of women and a program barring salacious conversations, lustful thoughts and masturbation should be insisted on

The married man who suffers from either complete or partial impotency has quite another problem This man must first be examined to see if his sexual organs are normal anatomically The wife must be similarly examined When both are found to be normal as to anatomic structure, inquiry must be made into the intimate relationship between man and wife

Sometimes there are conflicts between the pair Sometimes the wife teases the husband about his failure, thus making matters worse The most difficult situation arises from partial impotency,

for under this heading comes premature ejaculation. This is some-times incurable. It is always psychic. Some patients can and do cure themselves. It is somewhat akin to speech defects. In a young husband, such a condition need cause no worry for usually after the couple becomes better acquainted and sexual relations occur often and regularly control is established. One must carefully explain to the patient that there is no disease or defect in his sex apparatus. Furthermore he must be assured that a previous attack of gonorrhea, which may be troubling his conscience, has nothing to do with it. Plenty of rest, not only general but sexual, with periods of conti nence, is essential for a cure. Circumcision is sometimes advisable since toughening of the mucous surface of the glans penis makes it less sensitive. Various types of anesthetizing jellies have been applied to the glans just before coitus to deaden extreme sensitivity and further retard ejaculation. However all of these measures some times fail Time alone cures the largest number

The Sulfonamides
and Antibiotics in Urology

THE SULFONAMIDES and the antibiotics—penicillin and stre
mycin—have ushered in a new era in the cure and prevention
infectious diseases We first made use of the sulfonamides in 1
and 1937 and then we were astonished at the power these ben:
ring, diazo compounds possessed True, they have been fo
poisonous to man in a few instances, but they are much n
toxic to pathogenic micro-organisms It is also true that imm
strains of bacteria developed, so we must contend with the p
lem of sulfonamide-fast organisms When resistant strains be
to be a real problem, the antibiotics, penicillin and later stre
mycin, were introduced. These new substances destroy pathog
organisms on a basis different from that of the sulfonamides
can be used in conjunction with them The antibiotics are not w
out their reactions and sensitizations, however, since their n:
may be legion, they offer the promise of many new preparation
come For the first time in the long struggle against infection
have in our hands effective weapons with which we can conc
our ancient enemy, bacterial disease

In urology we often deal with infection within the body ca
which, localized or not, is always a threat to life Formerly, m
localized infections could be cured only by incision and drain;
with our new aids we can, and do, cure many diseases for wl

the body once had to provide its own antibodies and immunity We find that, in our field particularly the disease sometimes yields magically to treatment, only to return promptly when treatment is relaxed. Then it becomes necessary to carry out a complete urologic examination to try to discover the underlying cause, which might be a stone a tumor or other obstructive uropathy We should not neglect these great aids to the clearing of infection so that instrumentation of the urinary tract or operation can be safely carried out.

The Sulfonamides

Although we are well acquainted with a long list of sulfonamides, for our purposes we commonly use four sulfacetamide (formerly called sulamyd), sulfathiazole, sulfadiazine and sulfanilamide. In our opinion the newer sulfonamide compounds possess no great advantages over these four If, however, one wishes to use any or all of the newer compounds, the following facts apply to them as well. Some of these compounds we have used for 10 years and we have come to know both their virtues and weaknesses We have used them orally intravenously and locally in wounds.

Sulfacetimide

This drug, we have found, produces less toxic reaction than the other sulfonamides in amounts necessary to sterilize the urine, and for this reason it has long been a favorite with us. Although sulfacetimide is an acetyl sulfanilamide, it is not identical with that formed by the body from sulfanilamide. It has been shown experimentally that sulfacetimide has the lowest toxicity of any of the sulfonamides we have used, and this holds true for both the immediate toxicity and the chronic toxicity values. Furthermore, David Lehr has shown that it is 115 times more soluble in water than sulfathiazole. Because of this marked water solubility it is possible to obtain a high urine concentration of the drug with a relatively low blood level. We have used this particular compound in combating kidney infections since 1938 and we have never had a case of anuria from blockage of the kidney with sulfacetimide crystals.

It is our conviction that sulfacetimide is the best compound for common infections of the kidney, although it is not as effective against gonorrhea as other sulfonamides

DOSAGE —*Orally*—In kidney infections such as pyelitis and pyelonephritis, as well as infected hydronephrosis, pyonephrosis, calcareous disease with infection and cystitis, we prescribe doses of 7½ gr three times a day after meals for four days Each period of medication is followed by a rest period of from four to seven days Sometimes larger doses are used, e g, to maintain a constantly high blood level, 15 gr are given every three hours continuously until the desired clinical result is obtained Such treatment can be safely continued over a long period of time If sulfathiazole is given in this manner, about 15 per cent of patients become sensitized, but this has not happened in our experience with sulfacetimide

In infections of the urinary tract which often accompany and complicate renal or genital tuberculosis, we have found sulfacetimide highly effective. It is given orally in three or four day courses for as long as six months, one 7½ gr dose being given three times a day. We routinely use sulfacetimide in 7½ gr doses three times daily for three days before transurethral resection of the prostate and for four days after the operation. Until recently, no cases of epididymitis developed after such treatment, but within the past year we have encountered several despite this medication This and other observations suggest that the sulfonamides are losing some of their effectiveness

We have found that some patients who can take none of the other sulfonamides can take sulfacetimide Patients who develop headache and a toxic feeling when taking sulfacetimide usually tolerate the drug if two 5 gr acetylsalicylic acid tablets to each 7½ gr. sulfacetimide tablet are given in one dose at bedtime The blood levels are not constant, but the results often are surprisingly good.

Intravenously.—The sodium salt of sulfacetimide can be used intravenously, but we prefer sulfathiazole or sulfadiazine

Locally—In wounds we use sulfathiazole because all operating rooms are supplied with it in finely divided crystalline form.

Sulfadiazine and Sulfathiazole

These drugs are considered together inasmuch as both have their advocates and it is a matter of conjecture as to which is the most effective. The extensive use of sulfadiazine by the armed forces may have given some a false impression of its efficacy compared with that of sulfathiazole. Both drugs are effective against any of the coccic organisms and against bacteria of the colon bacillus group Their use in gonorrhea has been largely superseded by penicillin, but in penicillin fast cases of gonorrhea a full course of either sulfathiazole or sulfadiazine should be prescribed. In stubborn cases both can be given simultaneously

DOSAGE.—*Orally*—In acute gonorrhea, when penicillin has failed or when complications such as posterior urethritis prostatitis, prostatic abscess, salpingitis, pelvic inflammation Bartholins abscess, chronic anterior urethritis, cowperitis, etc., have developed, either sulfathiazole or sulfadiazine should be given. We believe sulfathiazole to be the more effective in gonorrhea. Four doses of 1 Gm. each should be administered every six hours during each 24 the average patient will tolerate this dosage well. Sometimes four times daily after meals and at bedtime may suffice, but often this is too indefinite. Administration at six hour intervals sustains the blood level of the drug more evenly If enteric-coated tablets are used, it is wise not only to increase the dosage by one third but also to observe whether some of the tablets are not passed almost intact through the intestinal tract. In treating acute gonorrhea, sulfathiazole should be given at the rate of 60 to 80 gr a day for eight days without interruption unless serious intolerance develops. Estimation of blood levels is not necessary in every case. It is far more important to keep account of hemoglobin estimations and red and white blood cell counts The patient should be specifically instructed to drink water freely and the physician

should check the urine several times weekly to ascertain whether the urine appears dilute, its specific gravity is low and it is free of red blood cells, sulfonamide crystals and albumin The presence of any of these substances in the urine should be taken as an indication that an excessive amount of sulfonamide is being excreted and that the quantity and concentration are sufficient to provoke kidney irritation The concomitant administration of 1 Gm of sodium bicarbonate for each gram of either sulfadiazine or sulfathiazole will tend to keep these drugs in solution and to prevent their precipitation in the urine Cases not responding to the foregoing sulfonamide therapy, either with or without adjunctive penicillin therapy, should be treated as suggested in the following chapter on gonorrhea

The same dosage applies in cases of chancroid and lymphopathia venereum In pyelitis, pyelonephritis and cystitis, one 7½ gr tablet three times daily until cured is quite satisfactory

Intravenously—Sulfadiazine and sulfathiazole are both available in the form of a sodium salt which can be used intravenously in the more seriously ill The sodium salt of sulfadiazine may be administered in a 20 per cent solution (4 Gm to 20 cc of distilled water) or may be further diluted with distilled water and given by venoclysis

Locally—In wounds, the microcrystals of sulfathiazole may be used The use of a fine powder in cavities is not recommended, for considerable lumping of the substance is apt to occur Usually not more than a total of 3 Gm of the drug should be used, owing to the danger from systemic absorption In treating local lesions such as chancroid and lymphopathia venereum, as well as inguinal adenitis (buboes), it is advantageous to apply the drug directly to the lesion

Sulfanilamide

Other sulfonamide drugs have largely superseded sulfanilamide in the oral treatment of urinary tract infections At present it is the drug of choice in but one urologic condition—erysipelas fol-

lowing circumcision. This once dreaded complication of a simple procedure is now a seeming rarity but, should it occur it responds promptly to oral sulfanilamide therapy. In severe cases sulfanilamide can be administered intravenously, in daily doses of 5 Gm. per 1000 cc. of distilled water for the average adult.

Locally.—Some surgeons prefer sulfanilamide for direct application in wounds, and it appears to work about as well as any of the sulfonamides. Usually not over 3 Gm. of the drug should be used in this manner. We use either sulfanilamide or sulfathiazole regularly in wounds. In nephrectomy for tuberculosis, in only one case has postoperative sinus developed in our experience since we have used the sulfonamides locally. When the wound is closed the line of incision is covered with a layer of the microcrystals, a tongue depressor being used as a spreader. A strip of vaseline gauze is then placed over the wound and the usual gauze dressing is applied. This usually prevents suppuration and even stitch abscesses are rare when this method is followed.

Untoward Reactions to the Sulfonamides

There can be no question that the sulfonamides are a great boon to mankind. They have however some effects that are not curative. Their toxic by-effects have been greatly magnified by many writers. We are rather of the opinion that the greatest danger from their use lies in the physician's failure to recognize an untoward reaction.

The sulfonamide compounds vary in toxicity. Sulfanilamide produces the most varied and perhaps the most severe reactions. Sulfathiazole and sulfadiazine are less toxic, and sulfacetimide causes fewer untoward reactions than most of these drugs.

Cerebral Symptoms.—Headache and dizziness, vertigo and vomiting may follow the administration of sulfanilamide and, to lesser degree, sulfathiazole and sulfadiazine. Frequently there is clouding of the sensorium, with inability to concentrate. A patient who has important decisions to make should be warned of this. Loss of sense of equilibrium and a failure of muscular co-ordination are

sometimes pronounced Judgement of distance and space and depth perception, as well as ability to judge the speed of moving objects, may be affected in a manner dangerous to aviators, locomotive engineers, bus drivers, steel workers and the host of drivers of private automobiles For this reason if no other, the law should prohibit and prevent anyone but qualified physicians from prescribing the sulfonamides No patient should take any of them on his own responsibility, nor should they be prescribed without the patient being told of the possible effects Of course, this latter can be overdone it is better that nervous or unstable persons who are hospitalized do not know all the hazards

Gastro-Intestinal Symptoms —Some of these are of cerebral origin Complaints of pain in the region of the stomach and digestive disturbances are not uncommon They are almost never serious, but usually require that the medication be temporarily discontinued Three or four days later, or whenever the disturbance appears to have subsided completely, another attempt at the same treatment may be made, but if the same symptoms appear again sulfonamide therapy will have to be abandoned and the case will have to be approached with the traditional therapeutic measures

Skin Rashes —One common type is scarlatiniform, and another is morbilliform Usually the latter is accompanied by itching, and sometimes by fever If the rash is overlooked and treatment is continued, hair may fall out Sometimes these rashes are akin to anaphylaxis We have seen one case in which the patient was thus sensitized, and a series of large, raised, reddened lesions, extremely sore and tender, appeared on various parts of the body At first they followed the administration of sulfanilamide When that drug was discontinued the rash subsided, leaving pale, liver-colored spots the size and shape of the original lesion These gradually faded over a period of months Six months later the patient took one 5 gr tablet of sulfapyridine Within a few hours every one of the discolored spots blossomed into a lesion exactly like the first one No more sulfonamides were taken for almost a year By that time sulfathiazole was

available and the patient took one 5 gr tablet of it—with the same result. After a lapse of several months one half of a 7½ gr sulfacetimide tablet was taken. The patient became violently ill, and all the skin lesions reappeared. Whether such a person can ever be desensitized we do not know

Fever is not a rare complication. It is estimated that in about 15 per cent of the cases in which a patient has previously had the drug starting the medication anew will cause this reaction. We have known a single 5 gr tablet of sulfathiazole to cause an increase of temperature to 107 5 F within a few hours of ingestion.

Cyanosis, according to our experience, is caused by only one of the sulfonamides, sulfanilamide. The ghastly appearance of the patient, due to sulfhemoglobinemia, is often alarming It was early learned that by combining with the sulfanilamide 1 gr or less of methylene blue, normal color could be restored and maintained.

Conjunctivitis of mild degree is sometimes seen but is usually transitory

Acidosis is a fairly common result of sulfonamide therapy Sodium bicarbonate (10 30 gr three times a day after meals) effectively corrects the condition which is never serious.

Jaundice may be an important sign for necrosis of the liver may result if the drug is not withdrawn immediately When it is discontinued the patient should be instructed to drink two glasses of water every hour for two days. This will effectively and quickly rid the system of all traces of the compound.

Anemia.—All the sulfonamides carry the threat of decreasing the number of red blood cells and the amount of hemoglobin. It is for this reason that, as has been stated, blood counts and hemoglobin estimations should be made just before medication is started and every three days, especially when treatment must be prolonged. Occasionally anemia sometimes of the hemolytic type, develops rapidly after one small dose of the drug

Agranulocytosis and Leukopenia.—The white blood cells are sometimes adversely affected by sulfonamide therapy Fortunately

agranulocytosis is rare, but a leukocyte count should be done before starting the treatment and at three day intervals If the white cell count falls below 4,000 per cu mm, the drug must be discontinued and all traces of it should be cleared from the system by the drinking of two glasses of water hourly for two days Such destruction of the white blood cells is a serious development, for which the prognosis is always grave Immediate blood transfusion should always be considered in such crises

Leukocytosis—Sometimes it is difficult to determine whether an increase in the white blood cells is due to the disease or the drug It is definitely known that leukocytosis occasionally develops as a result of sulfonamide therapy

Pain may occur in the stomach or the liver We have known severe pain to occur in the liver accompanying drug fever, and there may be pains in the bones and joints

Renal damage—Both sulfapyridine and sulfadiazine, like sulfathiazole, may produce renal damage Sulfapyridine concretions are usually deposited in the renal pelvis and the ureter, whereas sulfadiazine deposits are found in the smaller renal tubules This subject is fully discussed in Chapter 11, under "Sulfonamide Deposits" (p 211) Whenever this type of renal damage occurs, the patient complains of pain over the kidneys in the back or along the course of the ureter, and his urine contains red blood cells Administration of 10 to 30 gr of sodium bicarbonate three times a day and two glasses of water every hour may dissolve the deposits In the case of sulfapyridine, ureteral catheterization and irrigation with distilled water may dissolve the concretions Reactions to neoprontosil are mostly the same as those to sulfanilamide, and their intensity varies with the dose given

Other reactions—Swelling of the joints, resembling rheumatism, is sometimes seen Peripheral neuritis, enlargement of the liver and ascites are rare, but have been reported

The benefits derived from therapy with the sulfonamides far outweigh its dangers There are many ways in which the drugs may

be given. Sometimes trouble may be avoided by using enteric-coated tablets. Some individuals are so annoyed by such side-effects as a feeling of fulness and pressure in the head together with malaise that they feel completely incapable of carrying on their regular occupations. In such cases, as we have said, we have often found that three 7½ gr. tablets of sulfathiazole or sulfacetimide can be given at bedtime together with two 5 gr. acetylsalicylic acid tablets. Good therapeutic results may be obtained this way though the blood levels are not constant.

Other Sulfonamides in Urology

Various sulfonamides have had periods of popularity in the past, and other preparations will undoubtedly be introduced. Often when the anticipated response to one preparation does not occur another may be tried.

The other sulfonamides that are sometimes used today to control urinary tract infections are sulfapyridine, sulfamerazine and neoprontosil. The dosages of sulfapyridine and sulfamerazine are the same as for sulfathiazole and sulfacetimide, while the dosage of neoprontosil is the same as for sulfanilamide. The usual tablet of sulfapyridine or sulfamerazine is 7½ gr., but the tablet of neoprontosil contains 5 gr.

Penicillin

In 1929 Alexander Fleming noted the antibacterial properties of a certain laboratory mold which proved to be of the genus Penicillium. It was not until 1939 however that the countless strains of penicillium were examined and then only one, a strain closely resembling Penicillium notatum, was found to exhibit the desired antibacterial properties. By 1940 work was begun and by 1942 quantities of penicillin sufficient for adequate clinical trial were available. In the ensuing months the production mounted until finally there was enough for both the armed forces and the general public.

Penicillin has been found of considerable value in the treatment of diseases of the urinary tract, and it is the best drug we have for the treatment of gonorrhea Its chief criticisms have been its instability, its rapidity of excretion and the necessity for intramuscular injection The criticism of instability is especially true of sodium penicillin, which must be kept at a temperature of 5 C or less (41 F) Furthermore, sodium penicillin is hygroscopic and cannot be used after the ampule has once been opened Calcium penicillin, however, is more stable, will keep at room temperature and is not hygroscopic The excretion rate in both is about the same

Penicillin is important in the treatment of urinary tract infections due to gram-positive cocci, chiefly Staphylococcus aureus and Staphylococcus albus It can and does cure both hemolytic and nonhemolytic streptococcic infections of the urinary tract and is, therefore, a great aid in the treatment of some cases of acute pyelonephritis In acute epididymitis or acute prostatitis, either venereal or nonvenereal, penicillin is of considerable help, since these infections are usually of streptococcic or staphylococcic origin However, it is of no particular importance in chronic infections of the epididymis or prostate It is apparently without effect in the most common infections of the upper urinary tract, those due to the Bacillus coli variant, Escherichia coli It is of doubtful value in the treatment of urinary tract infections due to Bacillus pyocyaneus or Bacillus proteus, and it has no curative value in the treatment of tuberculosis

In syphilis, penicillin will produce rapid disappearance of the spirochetes from primary, secondary and gummatous lesions The lesions themselves will heal as rapidly as with arsenical and bismuth therapy The use of penicillin in the treatment of syphilis is discussed more fully on page 275 We wish to emphasize the importance of following up syphilitic patients who have been treated with penicillin

DOSAGE AND ADMINISTRATION —Penicillin can be administered intramuscularly, intravenously or subcutaneously, used top-

ically or given by mouth. Intramuscular administration is most effective given at intervals of three to four hours. The blood concentration reaches a maximum in 15–30 minutes and, after remaining fairly stationary during the next half hour gradually diminishes. At the end of three or four hours only traces of penicillin can be found in the blood.

One hundred thousand units of penicillin can be dissolved in 1 cc. of water; however for practical purposes we find that 100 000 units dissolved in 4 cc. of chemically pure distilled water or normal saline works best. There is some evidence that dissolving penicillin in smaller amounts of water increases the duration of its effectiveness. The use of a smaller amount certainly renders the injection less painful.

The intramuscular dose of penicillin varies considerably with the condition treated. In gonorrhea, 20 000 units every four hours for five doses is often sufficient, although we now advocate at least a total of 200 000 to 300 000 units. We have found that 50 000 units administered twice daily for two days is effective and is more satisfactory for office treatment. In mild staphylococcic infections of the lower urinary tract, 50 000 units twice a day for three or four days is usually sufficient, whereas in the more severe infections common in the upper urinary tract, 1 000 000 to 3 000 000 units given over a period of two to three weeks is necessary. In syphilis, 40 000 units every four hours for eight days or a total of 2 400 000 units is at present the minimum recommended dose. To increase the duration of the effect of intramuscular penicillin, calcium penicillin has been combined with 4.8 per cent beeswax in peanut oil. A single dose of 300 000 units will show demonstrable quantities of penicillin in body fluids for a period of 24 hours.

When given intravenously 90 per cent of the penicillin will disappear from the blood in 30 minutes. If in the seriously ill intravenous fluids are necessary penicillin can be mixed with intravenous fluid and given by the drip method. Usually 100 000 units of penicillin per liter is given either in distilled water or

in glucose solution, as large quantities of saline may cause edema

The subcutaneous administration of penicillin is useful for adults or children who are quite ill Two hundred thousand units of penicillin per 1,000 cc of solution are given. Although penicillin is seldom used topically, a bacteriostatic jelly containing 200 units of penicillin per cubic centimeter is sometimes found of value in urologic practice

Penicillin is rapidly destroyed when given orally Attempts to prevent its destruction by gastric acidity have been made by combining penicillin with trisodium citrate or with aluminum hydroxide Oral administration can still be considered experimental, but further evidence may appear in the near future It is much more expensive to the patient, for much greater amounts are required

Untoward Reactions to Penicillin

Toxic reactions from penicillin are few Most of the reactions seen are probably due to impurities in the preparation of the drug, for only 20 per cent of what we know as penicillin is actually the drug itself The lethal dose for human beings is far above the therapeutic dose and is at present unknown In animals, a single dose of 10,000 units per kilogram subcutaneously or 50,000 units intravenously was found to cause death For a 70 kg adult male this represents a dose of 700,000 units subcutaneously or 3,500,000 units intravenously

Skin Rashes—About 2–5 per cent of patients on penicillin therapy develop urticaria This reaction may appear on the first day, but may also be seen at any time and is common during the second week of treatment. The appearance of urticaria is no contraindication to continuing treatment. If the treatment is discontinued and again begun, the urticaria may reappear Generalized dermatitis or a vesicular eruption occasionally is seen

Low Grade Fever—A fever may continue after the clinical signs of infection have disappeared This will subside when the penicillin is discontinued.

Gastro-Intestinal Complaints—Rarely a patient will develop abdominal cramps diarrhea or nausea and vomiting.

Intramuscular pain at the site of injection is a common complaint However we have found that by reducing the total injection to 1 or 2 cc. the pain is much less, and, if the injection is made in the upper outer quadrant of the buttocks or in the outer aspect of the anterior portion of the thigh, there should be little cause for complaint.

Thrombophlebitis from Intravenous Injection—This is not uncommon in patients receiving intravenous penicillin. Both the irritating effects of the drug and the irritation of the needle are factors in producing this condition.

Herxheimer reactions are common in the treatment of syphilis by penicillin. This reaction is considered more fully in the section on syphilis.

Streptomycin

Streptomycin is obtained from one of the actinomyces of the soil, the Actinomyces griseus. Like penicillin, it has a low toxicity and it is excreted rapidly Streptomycin appears to work the best when given intramuscularly· however it can also be given intravenously subcutaneously orally or topically Because of its rapid excretion, it is given at three or four hour intervals when given intramuscularly The dose required is approximately ten times that of penicillin.

The chief action of streptomycin is against gram-negative bacteria and, therefore, it is effective in many conditions of the urinary tract in which the sulfonamides and penicillin have failed. Penicillin is primarily of value in gram positive infections one exception being the gram-negative gonococcus Streptomycin is most effective in Aerobacter aerogenes infections and thereafter in a decreasing scale of action, against Escherichia coli, B proteus, Staphylococcus aerogenes, Streptococcus fecalis and Pseudomonas aerogenes. Of interest to everyone are the promising reports on the treatment of

tuberculosis with streptomycin Just how effective it will be remains to be proved by clinical experience

It must be remembered that streptomycin has received wide publicity in lay journals and in the public press, in fact, the public has been led to believe that everything said of it is accomplished fact There are reasons why the appearance of this new therapeutic agent on the pharmaceutical market will probably be delayed Congress passed a special act to insure standardized control of penicillin by requiring certification by the Food and Drug Administration before its distribution for general use A similar act of Congress for standardized control of streptomycin is probably in the making

Streptomycin seems to have more toxic properties than penicillin, and it is not yet clear whether these properties are inherent in the drug itself or in the minute quantities of impurities present.

We are unable to supply enough first-hand experience with this new drug to write authoritatively Undoubtedly several new antibiotics will be developed and publicized Adequate directions for dosage, indications, limitations and dangers will be supplied before each one is released for general use On streptomycin, gramicidin, tyrothricin, clavacin, flavicin and a host of others to come, we must await the clinical leveling properties of time before we can accurately assess the therapeutic value

Gonorrhea

WE ONCE believed that gonorrhea like the poor would be with us always. That was in the days before the modern era of thera peutics. Now there is every indication that the disease can and will be eliminated. The disease would have been eradicated long ago were it not for the fact that it has its roots deep in the social fabric of all nations. Since the advent of sulfonamide compounds and penicillin, gonorrhea is on the way to becoming a rare disease

Formerly the free clinics were crowded with these trying and un interesting cases. The complications resulting from gonorrhea were legion. The women s wards were filled with women with salpingitis, and Bartholin s abscesses abounded. Now it is rare to find even one woman with pus tubes on a large gynecologic service

More progress has been made toward the eradication of gonor rhea since 1937 than in all the ages that have passed. This change has come about not because of any improvement in public morals nor because of the sagacity of the social agencies, but solely because of the sulfonamide drugs and penicillin and their application to the problem by the general practitioners of this and other countries.

DIAGNOSIS.—Unfortunately not all physicians bother to make a stained smear of a urethral discharge. Some classify every urethral discharge as gonococcic, which is, of course, wrong. We have found that we must revise the former figures as to the ratio of gonorrheal to nongonorrheal discharges. Formerly nongonorrheal or nonspecific urethritis comprised about 30 per cent of all urethritis cases.

Now the ratio has changed so that the nongonorrheal cases comprise about 75 per cent It is better, however, for the physician to consider every urethral discharge as possibly gonococcic until proved otherwise than to diagnose "strain" or "urethral catarrh"

TECHNIC

Four slides should be smeared with pus from the discharge One of these slides is stained with methylene blue, washed and dried and viewed under the microscope The presence of the characteristic, intracellular, coffee bean-shaped diplococci lying in groups of two or four, or multiples thereof, is all that is needed for diagnosis Another slide may be stained by the Gram method, as follows (1) Dry and fix the film with heat. (2) Stain five minutes with aniline water gentian violet. (3) Pour off the excess stain and apply Gram's iodine solution for two to three minutes (4) Decolorize with 95 per cent alcohol as long as color comes away (5) Wash in clean water (6) Dry with a blotter (7) Counterstain with dilute carbolfuchsin (8) Wash and dry (The bacteria which are stained red by this method are known as gram-negative) The remaining two slides may be sent to a laboratory for examination if this is deemed desirable The diagnosis is usually easy

In the female a somewhat different situation exists Often the woman is brought in by a man who accuses her of infecting him The doctor may make a cursory examination of the woman and pronounce her clean. Nothing could be more dangerous The woman may be a carrier She may harbor the germs in the cervical glands, and many slides must be made before the organisms can be found We have made as many as 30 slides before finding the gonococci in the cervix of a suspect.

Men who have recently had gonorrhea and wish to know if they are cured present a problem Sulfonamide- and penicillin-treated patients do not respond to the old standard tests of cure, which were (1) allowing the patient to indulge in sexual intercourse, (2) permitting the patient to drink alcoholic beverages, (3) passing a

sound. Patients treated by the sulfonamides and penicillin, even though they are not completely cured have no recurrence of the discharge in response to these tests. In these cases the patient is instructed to bring to the office a specimen of the first urine voided in the morning For this he is given a sterile bottle. He is instructed to cleanse the penis with soap and water and to sterilize the meatus with a pledget of cotton dipped in alcohol. From this specimen a quantity is centrifuged and smears are made and stained by the Gram method. Further cultures should be made from this specimen. In addition, the prostate is massaged and a specimen of prostatic fluid is collected under aseptic precautions. This is examined and cultured the same way as the urine specimen. When centrifuged specimens of the first urine voided in the morning no longer show pus cells the patient is cured.

Most books state that culture methods are extremely reliable for diagnosis. We know from experience that it is difficult to grow the gonococcus in culture mediums when we are doubtful regarding the diagnosis and quite easy to obtain good cultures when the diagnosis is apparent from the slides and from the clinical signs and symptoms The culture method, therefore, may fail in the very cases in which it should become the final test, although in the hands of technicians experienced in this particular work culture methods may be relied on.

When cultures of material which may be suspicious of gonorrhea are desired, it is best to write to a reliable laboratory explaining the exact problem and just what information is needed. The laboratory will be glad to co-operate by sending containers and details as to how the specimen should be collected. It is impossible for any doctor to have both the skill and technical knowledge and the time to carry out such culture methods or successfully and reliably to grow the gonococcus.

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TREATMENT—Just prior to the introduction of the sulfonamides, fever treatment by means of the heat cabinet had brief popularity. The fever treatment was and is the most exquisite form of torture

ever devised in the name of therapy Many patients swore they would rather have the disease than endure the treatment However, in certain cases fever treatment is to be recommended and is sound therapy

Modern treatment of gonorrhea consists in the administration of penicillin, the sulfonamide compounds and, if need be, streptomycin in adequate doses At the same time, proper control of the patient is necessary so that the greatest degree of co-operation is obtained When all these conditions are fulfilled, a cure results in 98–100 per cent of cases

Of the Male—Penicillin is the best drug we have for the treatment of gonorrhea One hundred thousand units should be administered intramuscularly within 24 hours, preferably in doses of 20,000 units every four hours However, from a practical standpoint, this is often not possible We therefore give 50,000 units morning and evening for two days with results about as good, although we know we cannot maintain a high concentration in the blood for more than a short period of time We prefer to dissolve the penicillin in small amounts of distilled water, usually about 1 cc We have tried the single injections of penicillin in beeswax and peanut oil but find some objections to this method

When a patient is treated with penicillin, the discharge will generally cease within six hours The gonococci disappear rapidly, and the patient will often be considered cured in 48 hours However, it is wise to follow all penicillin-treated patients for a week to 10 days to make sure there is no recurrence The urine should be negative, both microscopically and macroscopically There should be no pus cells on microscopic examination of the specimen of centrifuged urine, although there may be epithelial shreds in the urine for several days

In some patients treated with ordinary doses of penicillin the discharge is only reduced for a few days, or recurs after being completely arrested. These patients should receive penicillin in larger doses, usually 300,000 to 400,000 units in divided amounts

We often give sulfonamides together with penicillin, and certainly after a recurrence sulfonamides are indicated. The average male patient can tolerate eight or ten 7½ gr sulfathiazole or sulfadiazine tablets each 24 hours In most cases the patient is instructed to take two tablets after each meal and then two or four more tablets at bedtime. This program must be continued without interruption for seven days Careful follow up is then necessary

The patient under treatment must abstain from liquor and sexual relations and from heavy lifting or any exercise. He should be on a bland diet, drink a glass of water every hour during the day be given two four-day courses of penicillin and two four-day courses of sulfathiazole or sulfadiazine (two 7½ gr sulfathiazole tablets every four hours) every month, and must be seen by the physician at the office at least three times a week.

One other group of patients demands our consideration that is the small group who are penicillin resistant and who can tolerate no form of sulfonamide compound. The course of treatment for such patients should be as follows

1 For the first four or five days, no urethral injections are used.

2 The patient is given santol oil orally in doses of 5 minims three times a day before meals.

3 He must take hot sitz baths for 20 to 30 minutes each day for the first week.

4. He must take copious amounts of water by mouth two glasses of water every hour is not too much.

5 After four or five days, the patient is given a prescription for protargol ¼ of 1 per cent and a B-D syringe no 2043 and instructed to inject a scant syringeful into the urethra twice daily He is first to void, to wash out the canal from within and cleanse the passage. The patient then makes the injection and holds it in the urethra for five minutes by the clock.

6 He is instructed to come to the office every day for the first two weeks, then three times a week thereafter As soon as the patient begins his home injections, the doctor should begin to inject a

syringeful of rivanol 1 1,000 solution at the office on each visit.

7 Smears should be made of the sediment in the first glass daily for the first week to note the progress of treatment After that, smears of the sediment should be studied once a week

Such a course of treatment for sulfonamide-sensitive patients may take as long as three or four months to bring about complete cure

Of the Female —The treatment of gonorrhea in women differs considerably from that in men In the first place, a woman may be infected but have little discomfort and practically no symptoms severe enough to bring her to a doctor In less than half the female patients is the urethra involved to the extent that urinary distress becomes a symptom The diagnosis is more difficult than in men. Smears must be made from the cervix, vagina and urethra One must be guarded in giving a clean bill of health to a woman suspected of harboring the gonococcus The woman may delay seeking medical advice until she has pus tubes or a Bartholin abscess Fortunately, such complications develop in less than 5 per cent of all gonorrheal women

No matter what the stage of the disease, the treatment is about the same

1 It is wise to give somewhat larger amounts of penicillin to women At least 200,000 to 300,000 units divided into doses of 20,000 to 30,000 units should be administered every four hours intramuscularly As in the male patient, 50,000 units morning and evening for two or three days may be found extremely satisfactory

2 We often combine penicillin therapy with sulfathiazole in an initial dose of four tablets of 7½ gr each, followed by two tablets three times a day after meals, and two to four tablets at bedtime This treatment is continued for one week

3 The patient is instructed to drink two glasses of water every hour

4 If the patient has even a slight fever, she is put to bed until it subsides

The foregoing program generally results in a cure within a week.

If at the end of a week the organisms are still found in smears of discharges from the cervix, urethra and vagina, further treatment is indicated. In addition to the continued administration of penicillin and sulfonamides, treatment for a second week is carried out as follows.

1 The patient must take hot sitz baths for 20 to 30 minutes daily for one week.

2. Some authorities advise against douches, but we have found that hot douches are sometimes of considerable value and that there is no danger of spread of the disease when penicillin and sulfathiazole are used. Douches of boric acid solution used as hot as can be tolerated, are suggested when there is considerable vaginal discharge. The physician must exercise his judgment as to whether or not a douche is advisable and would be of comfort to the patient.

3 Daily the vagina and cervix are exposed with a large speculum, the parts are dried thoroughly and, with a blower finely powdered sulfathiazole is blown onto the mucous surfaces.

At the conclusion of this second week of treatment, certain patients may remain uncured. Also there may be reinfection because the patient has further sexual relations with the man who infected her While this seems a remote possibility the idea must never be dismissed as impossible.

Fever treatment may be instituted when the disease persists more than four weeks. The patient should be hospitalized for this treatment, and technicians skilled in this particular form of treatment should take charge. Generally three or four heat treatments will suffice.

It was formerly believed that the course of acute gonorrhea in the female was influenced greatly if pus tubes were present. Under the older forms of treatment, the pus tubes remained unchanged even after a lapse of eight months to two years. Now however pus tubes rarely develop with penicillin and sulfonamide treatment.

Occasionally the doctor does not see the patient until she has pus tubes and pelvic peritonitis. Pus tubes may develop within 48 to

72 hours in some untreated patients The following treatment is recommended in such cases

1   The patient is put to bed, with a hot pad to the abdomen

2   Codeine 1 gr and aspirin 5 gr is given for pain

3   Penicillin in doses of 20,000 to 30,000 units is given intramuscularly every three hours Sulfathiazole, two 7½ gr tablets every four hours, is given for three to eight days This medication should be continued for eight days after the fever subsides

4   If there is considerable vaginal discharge, hot douches of boric solution may be given

5   Operation, now rarely necessary, should never be undertaken in the acute stage If necessary after eight or nine months, operation may then be carried out.

When is the female gonorrhea patient cured? The answer should be, when she can no longer infect a man who may have sexual relations with her.

Because of the great number of folds, crevices and recesses in the female genital tract, negative smears may not be the absolute criterion of a cure However, if slides made of discharges from the urethra, cervix and vagina are negative on three successive two-day intervals, the patient can usually be dismissed as cured. If she has no distressing symptoms the remaining gonococci, whether hidden or not, will die out in six to eight months without treatment of any sort If the patient will refrain from sexual relations, this is a perfectly safe course

Complications of Gonorrhea

Since the introduction of penicillin and sulfonamide therapy, complications are rare Naturally the great reduction in the number of cases of acute gonorrhea has limited the number and variety of complications, the reduction in number of the complications being proportionately greater than the reduction in number of acute cases This is due entirely to the sulfonamide and penicillin treatment

ACUTE POSTERIOR URETHRITIS —This complication is now comparatively rare It used to be one of the most painful and distressing

complications. What now passes for acute posterior urethritis is mild indeed. Generally it occurs in untreated patients. Penicillin and sulfathiazole started in the acute stage work a magic cure the treatment is the same as that for acute gonorrhea.

ACUTE GONORRHEAL CYSTITIS.—This was always a rare complication, and we have not seen a case for years. The bladder becomes contracted and the mucosa invaded with the organisms. The treatment is penicillin 20 000 units every four hours for five doses, or 50 000 units twice a day for two days. The combined use of penicillin and sulfathiazole is of value. The use of silver nitrate, formerly instilled into the bladder, is now considered archaic.

ACUTE EPIDIDYMITIS.—This is probably the most common complication we deal with but even it is rare. As a rule it puts the patient to bed. The onset may occur with chill followed by fever with temperature ranging to 104 F. Usually there is a prodromal neuralgia of the spermatic cord on the affected side. The swelling of the epididymis gradually increases during the following three or four days. Pain and aching may be intense when the swelling reaches its height. The discharge from the urethra disappears largely because of the fever. The swollen scrotum is hot to the touch and is reddened and inflamed. The wrinkles in the skin of the scrotum are smoothed out and the skin is tense and shiny. When examined by the inexperienced, the disease is often diagnosed "orchitis." The testus is, however, not involved. The epididymis which becomes so enormously swollen, almost completely surrounds the normal sized testus so that it can be located with difficulty. The amount of fluid that normally floats the testus within the tunica vaginalis is increased by several times, and this adds to the swelling. The diagnosis, as can be seen, is comparatively simple.

Treatment —1. The patient should be put to bed.

2. Codeine 1 gr and aspirin 3 gr in a capsule is given three times a day for pain.

3. Support for the swollen scrotum is provided in the form of a

bike support, or a Bellevue bridge of adhesive plaster can be used

4 An ice bag is applied directly to the scrotum for the first 36 hours, after that, heat from an electric pad is applied The heat is discontinued when pain subsides

5 Penicillin is given in doses of 20,000 to 40,000 units every four hours until 300,000 to 400,000 units are given, or until the fever and swelling subside (See Chapter 16 for detailed treatment of nonspecific epididymitis)

The fever subsides in about six days The swelling gradually recedes in 15 to 21 days, but may persist for many weeks in the form of a hard lump in the lower pole of the epididymis Nothing can be done about this, and the patient should be assured that it will return to normal in three or four months

ACUTE PROSTATITIS —Treatment is the same as for gonorrheal urethritis Penicillin is given in 20,000 to 40,000 unit doses intramuscularly every four hours until fever subsides

GONORRHEAL OPHTHALMIA —This rather infrequent condition responds readily to 20,000 units of penicillin every three hours for two to four days Sulfathiazole given in conjunction is also an aid

GONORRHEAL ENDOCARDITIS —Though uncommon, we have seen two cases One patient, seen before the days of the sulfonamide compounds, had chronic urethritis and stricture of the urethra When this stricture was dilated with filiforms and bougies, gonorrheal septicemia developed and the patient died At autopsy, gonococci were found in lesions on the tricuspid valves of the heart (Fig 98) The second case was in a man of 35 who complained of extreme dyspnea Pulse rate was over 140 and extremely irregular, and temperature was 103 5 F There were a profuse urethral discharge, marked dysuria and epididymitis There were many gonococci in the urethral smears He was married to and living with a woman who had previously given gonorrhea to another of our patients This man's blood showed gonococci in pure cultures He was hospitalized and given twelve 7½ gr sulfathiazole tablets daily for

one week. The fever subsided the third day the dyspnea and heart murmur disappeared the fifth day and he was home the tenth day He had no recurrence of the disease in any form He did not return

FIG. 98.—Gonorrheal endocarditis due to lighting up of old case of gonorrhea by passing a sound for stricture of the urethra.

to the woman who had infected him even though he had married her We regard this as a proved case of gonorrheal endocarditis and blood stream infection cured by sulfathiazole. Under the older régime he would have suffered the same fate as the first patient. Today such a patient would receive 20 000 to 30 000 units of penicillin every four hours for a period of five or six weeks.

SKIN MANIFESTATIONS —Cutaneous reactions, such as localized abscesses, are rare

URETHRAL STRICTURE —This was considered in Chapter 17 (p 311)

GONORRHEAL ARTHRITIS —This responds so well to penicillin and sulfathiazole that it is no longer a therapeutic problem, however, a few words on this subject may not be amiss Most patients who are above average intelligence fear gonorrheal arthritis above all other complications That this fear is unwarranted by the facts makes no difference There are two types of gonorrheal arthritis, acute and chronic

I The acute form develops during the first 10 days of the disease If it does not develop during that period, the patient may have arthritis but it is not gonorrheal The figures formerly given regarding the frequency of this type of arthritis have been completely revised since the introduction of chemotherapy Formerly it was estimated that it occurred in 1 to 2 per cent of cases of acute gonorrhea We have seen only one case since 1937 This complication is a polyarthritis The joints affected are the knee, elbow, wrist, jaw, hip and ankle in about that order The disease persists for 14 to 21 days, then gradually recedes This period can be shortened to a week with adequate treatment

Treatment —The following régime is satisfactory

1 Penicillin is given in doses of 20,000 to 40,000 units every four hours This may have to be continued for weeks if the disease does not immediately subside

2 Codeine ½ gr and acetylsalicylic acid 5 gr is given for pain Demerol in doses of 50 mg three times a day may be given for pain

3 Hot baths at 102 to 104 F are taken for 30 minutes each day until the disease is controlled

4 The prostate is examined and treated, if necessary, as described for prostatitis (p 255)

II The chronic form is usually a continuation of the acute stage

The chronic gonorrheal arthritis said to develop years after acute gonorrheal urethritis is largely a myth. There is really no such entity as gonorrheal rheumatoid arthritis. In cases in which the disease passed from the acute to the chronic stage we have seen deforming changes in the joints and cartilage around the joints. The synovial fluid became infected with gonococci, and when the fluid was aspirated gonococci could be isolated from this fluid. This resulted in ankylosis. Sometimes a slipping of a joint in the spine leads to spondylolisthesis.

Treatment —Penicillin is given in doses of 20 000 to 30 000 units every four hours until 300 000 to 400 000 units have been administered. Sulfathiazole may be given at the same time, 60 to 80 gr a day in doses of 15 to 22½ gr every three or four hours. Heat treatment may also be of value.

Prophylaxis against Gonorrhea

The prevention of gonorrhea in both males and females is as important as the cure. Penicillin and the sulfonamides have modified the old standard prophylactic ritual considerably Sulfathiazole should be taken even before exposure Four 7½ gr tablets of sulfathiazole (30 gr) are taken as soon as possible after exposure Tablets of penicillin may also be taken by mouth in 10 000 unit doses every three hours for four doses. Local application of penicillin jelly may be a great aid in prophylaxis against syphilis.

The full program, in addition to penicillin and sulfathiazole, is as follows

1 Wash the parts with soap and water preferably in a shower or tub

2 Dry and wash with alcohol

3 Dry the parts again and empty the bladder

4. With a ¼ oz. bulb syringe, inject into the urethra a 1 10 000 solution of metaphen and hold it in the urethra for five minutes, using the thumb and fingers of the left hand to keep the meatus closed.

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3 Dry the parts again and empty the bladder

4. With a ¼ oz. bulb syringe, inject into the urethra a 1 10 000 solution of metaphen and hold it in the urethra for five minutes, using the thumb and fingers of the left hand to keep the meatus closed.

5 Apply penicillin jelly to the penis and scrotum and allow to remain for several hours This is as good a prophylaxis against syphilis as the old mercury inunction

Gonorrheal Vaginitis in Female Babies and Young Children

Most of the literature on this type of vaginitis was outmoded by the introduction of penicillin and sulfathiazole The disease is characterized by a discharge from the vagina Urethritis seldom accompanies the vaginitis In most cases, smears made from the discharge and stained with methylene blue or Gram's stain will disclose the disease Cultures should be made in every instance for further substantiation of the diagnosis To be positive in the diagnosis is highly important, for to stigmatize a child by making a diagnosis of a venereal disease, with all its implications, is a serious responsibility.

It is important to have a frank discussion with the parents, to tell them the exact facts and to enlist their co-operation in treating the disease and protecting other children in the family

Penicillin therapy has superseded all other procedures Children tolerate penicillin well Generally 10,000 units of penicillin intramuscularly every four hours is adequate

There may be a small group of these little patients who are not cured by penicillin and sulfathiazole In such cases a complete restudy of the cases must be done It is here that it may occur that penicillin and the sulfonamide compounds eradicate the gonococcic infection and leave the nonspecific infections when both specific and nonspecific infections are present

The discussion of vaginitis in children is necessarily brief for the simple reason that specific remedies have been discovered to replace the meddlesome treatments of the past.

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